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WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

BY AMELIA B. EDWARDS.

III.—THE PHARAOH OF JOSEPH.

BUT, it will be asked, what was the name of this Pharaoh, and what place did he occupy in the succession of Hykshos kings?

Tradition, represented by the Byzantine monk, George Syncellus before mentioned, and also by John of Antioch, of whose work only a few fragments are preserved (see Müller: *Fragmenta historicorum græcorum*, vol. iv., p. 555), assigns the name of Aphobis to the Pharaoh whose dream was interpreted by Joseph. Now Aphobis, or Aphophis, is the Greek way of writing Apapi; and Apapi was a name borne by at least two Hykshos rulers, one of whom belongs to the 15th and one to the 17th dynasty. Of the first Apapi nothing is known but his name. It is the second Apapi under whom Joseph is believed to have flourished; and this Apapi—the Apapi of the 17th dynasty—was the last of the Hykshos kings. It was in his time that a tributary prince of Thebes, Rasekenen Ta-aken, raised the war of national independence which ended in the expulsion of the shepherds. Sphinxes and statues engraved with the name of Apapi have been found in the mounds of Sān (the Zoan of the Bible) where the Hykshos established their capital; and a succinct contemporary account of the war of independence is found at El Kab, Upper Egypt, sculptured on the walls of the tomb of a certain naval officer named Aahmes, whose father served on the legitimate side under Rasekenen Ta-aken, and who was himself distinguished for personal valour throughout the later campaigns of that same war, when the fortresses of Avaris and Sherohan were besieged and taken, and the Hykshos were driven from their last strongholds. In Apapi II., therefore, we are dealing with an historical personage; and in all that relates to the war of liberation and the expulsion of the usurpers, we are dealing with historical facts. The Sphinxes of Apapi are human-headed, and in their hard-featured, melancholy faces not only preserve the record of a singular and distinct Asiatic or Asiatic-Scythian type, but in all probability hand down to us the portrait of the king himself. The fortress-camp of Avaris (in Egyptian Ha-uar) exists to this day in the mounds of Tel Herr; and as for Rasekenen Ta-aken, Prince of Thebes, and King Ahmes I., by whom Apapi was expelled and Avaris captured, their mummies were both found last summer in the famous hiding-place at Dayr-el-Baharee, and are now on view in the Museum of Boolak.

Historians are agreed in representing the war of liberation as a very long war, and Professor Maspero attributes to it a duration of more than 150 years. I venture, however, to think that the hypothesis which makes Joseph the interpreter of Apapi's dream is incompatible with the hypothesis of so very long a war. I would even go so far as to suggest that Joseph must not only have risen to power under some earlier Hykshos king, but that the war did not, in all probability, last longer than thirty years. Let us first take the internal evidence of the Bible narrative. That narrative relates to the youth and prime of Joseph, and the scene is evidently laid in a time of profound peace. There is plenty in the land, and there is famine in the land, and people come from far and near to buy and sell; but there is no hint of either internal or external strife. It is even said that Joseph, after he had bought up the land for Pharaoh, removed the people to cities "from one end of the borders of Egypt even to the other end thereof;" a precautionary measure which, by the way, was peculiarly Egyptian, and which Rameses II. is especially recorded to have taken in dealing with captives from the north and captives from the south, whom he transplanted in enormous gangs, from one extremity of the country to the other. But neither Rameses II. nor Joseph could have so transplanted large bodies of either citizens or captives, if the whole of Upper Egypt had been in arms. Seeing, also, with what minuteness of detail the early biography of Joseph is given, it seems impossible that no mention should be made of a harassing and prolonged civil war, if such a war had at that time distracted the country. Besides, it is expressly stated that "Joseph was thirty years old when he stood before Pharaoh;" and although the age at which he is said to have died—namely, 110 years—was a typical phrase in use among the ancient Egyptians to express the ideal length of days, and is, therefore, not perhaps to be accepted literally, yet it is certain that Joseph lived to be a very aged man; so aged that he may well have flourished under two, or even under three, Pharaohs. Be this as it may, however, I do not think we can be very far wrong if we place the promotion of Joseph under the predecessor of Apapi; nor if we conclude that, having, as an old man, witnessed the beginning and greater part of the war of liberation, he died, was embalmed, and "put in a coffin in Egypt," towards the end of the reign of Apapi, the last Hykshos king.

The immediate predecessor of Apapi is identified by Dr. Birch* with a certain Hykshos Pharaoh called Sut-aa-peh-peh (or Sut-aa-peh-ti) Nubti, whose name appears on a tablet discovered by the late Mariette Pasha in the ruins of Sān (the Zoan of the Hebrews, the Tanis of the Greeks), where the Hykshos established their capital city. In this tablet, which was put up by a certain governor of the province who held office under Rameses II., it is recorded that the king ordered the tablet to be made in honour of his ancestors, and that the governor came to Zoan "on the 4th day of the month of Mesori (the twelfth month of the year) of the 400th year of Sut-aa-peh-peh Nubti, Son of the Sun," in order to be present at the festival of its installation.

* See "Records of the Past," vol. vi. p. 36.

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'The interest of this tablet," says Mariette Pasha, in his Appendix to the Catalogue of the Boolak Museum, "centres in the date. This date is not Egyptian; it is Egypto-Asiatic, as were the inhabitants of Tanis. Four hundred years before, a shepherd-king, the Nubti of our tablet, had endowed the Hykshos with a fixed calendar grafted upon the sacred year of the Egyptians. It is from this calendar that the date of the tablet is taken, so furnishing an additional proof that in Lower Egypt, under Rameses II., there yet existed a stock of alien races whom the civilisation of Egypt had not entirely deprived of their autonomy."

In other words, the Hykshos calendar was still in use in the time of Rameses II., four hundred years after its institution by Sut-aa-peh-peh Nubti. This festival of the erection of the tablet was accordingly said to have taken place in the year of Nubti 400; just as an event in the history of a Mohammedan country would be reckoned from the Hegira, or Year of the Flight; or as an event in the history of a Christian country would be reckoned from the Christian era.

Unfortunately, the regnal year of Rameses II. is not given; and there is nothing in the text of the tablet to show at what period in the life of this famous Pharaoh the festival of the tablet was commemorated. We therefore only know that the 400th centenary of the Hykshos era coincided with one of the sixty-seven years of the long reign of Rameses II. The coincidence is too vague to be called a synchronism; yet, despite its vagueness, it affords a kind of basis for rough calculation.

(To be continued.)

HONEY ANTS.

By GRANT ALLEN.

THE Garden of the Gods in Colorado is a bit of show-scenery of the true American type—a green amphitheatre, studded with vast ledges and cliffs of red sandstone, weathered here and there into chimneys or pillars, in which a distorted fancy traces some vague resemblance to the sculptured forms of the Hellenic gods. Hither, a few years since, Dr. McCook of Philadelphia went on his way to New Mexico, where he wished to study the habits and manners of a famous, but little-known insect, the honey ant. To his surprise, he accidentally stumbled here upon the very creatures he had set out to find. There are two kinds of entomologists: one kind, now, let us hope, rapidly verging to extinction, sticks a pin through his specimens, mounts them in a cabinet, gives them systematic names, and then considers that he has performed the whole duty of a man and a naturalist; the other kind, now, let us hope, growing more usual every day, goes afield to watch the very life of the creatures themselves at home, and tries to learn their habits and customs in their own native haunts. Dr. McCook belongs to the second class. He forthwith pitched his tent (literally) in the Garden of the Gods, and proceeded to study the honey ants on the spot.

Like many other ants, these little honey-eaters are divided into different castes or classes; for besides the primary division into queens or fertile females, winged ants or males, and workers or neuters, the last-named class is further sub-divided into three castes of majors, minors, and minims or dwarfs. But the special peculiarity which gives so much interest to this species is the fact that it possesses, apparently at least, a fourth caste, that of the honey-bearers, whose abdomen is distended till it is almost spherical by a vast quantity of nectar stored within it. Dr. McCook opened several of the nests, and found these honey-bearers suspended like flies from the ceiling, to which they clung by their legs and appendages. All over the vaulted dome of the ant-hill, these little creatures were clustered in numbers, their yellow bodies pressed tight to the roof, while their big round stomachs hung down behind from the slender waist, perfect globes of translucent tissue, showing the amber honey distinctly through the distended skin. They looked like large white currants, or sweet-water grapes; and as they were actually filled with grape-sugar, the resemblance was really quite as true inside as out.

Where did the honey come from? That was the next question. Everybody knows that ants are very fond of sugar, and they often steal the nectar in flowers which the plant has put there to entice the fertilising bee. So much damage do they do in this way, that many plants have clothed their stalks with hairs, or sticky glands, on purpose, in order to prevent the ants from creeping up the stem and rifling the nectary. In other cases, however, plants actually lay by honey to allure the ants, when they have anything to gain from their visits, as in the case of those Central American acacias, mentioned by Mr. Belt, which have a nectar-gland on the leaf-stalk to attract certain bellicose ants, which so protect them from the ravages of their leaf-cutting congeners. Of course, everybody has heard, too, how our own species sucks honeydew from the little aphides, or plant-lice, which have often been described as ant-cows. But it is not in either of these ways that the honey-ants get their sugar. Dr. McCook had a little trouble in settling this matter at first, for the honey ants are a nocturnal species, and he had to follow them through the thick scrub, lantern in hand; still, he satisfactorily settled at last that they obtain the nectar from the galls on an oak, where it must simply be exuded as an accidental product of injury. The workers take it home with them, and give it to the honey-bearers, who swallow but do not digest it. They keep it in their crops ready for use, exactly as bees keep it in cells of the honey-comb. When the workers are hungry they caress a honey-bearer with their antennæ, whereupon she presses back a little of the nectar up her throat, and the workers sip it from her mouth. The honey-bearers, in short, have been converted into living honey-jars. They are thus passively useful to the community, for in this curiously-ordered commonwealth they also serve who only stand and wait.

How could such a strange result as this have been brought about? Dr. McCook, though not himself an avowed evolutionist, has supplied us with facts which seem to suggest the proper answer to this difficult question. He has shown that the rotunds (as he calls them) are not, in all probability, a separate caste, but are merely certain specialised individuals taken at haphazard from the worker-major class. He saw himself in the nests many worker-majors, which seemed at that moment actually in course of transformation into honey-bearers. Now, it is easy enough to understand why these social insects should wish to store up food against emergencies. At all times, the queen, the young female ants, the males, and the grubs or larvæ are entirely dependent upon others for support. Hence, alike among bees and ants, stores of food are habitually laid by, sometimes in the form of honey in combs and bee-bread, as with the hive-bee; sometimes in the form of seeds and grains, as with the harvesting ants. During the winter months or the rainy season, when food fails outdoors, there must be some reservoir at home to meet the demand of the starving community. Under such circumstances, any trick of manner which tended to produce

a habit of storing food would be highly useful to the nest as a whole; and, taking nests as units in the struggle for existence, which they really are, those nests which possessed any such trick would survive in seasons when others might perish. So the tendency, once set up, would grow and be strengthened from generation to generation, those ants which stored most food being most likely to tide over bad times, and to hand on their own peculiarities to the other swarms or nests which took origin from them.

A set of primitive ants, living upon the honey of the oak-galls, have no tendency to produce wax, like bees, because their habits with regard to their larvæ do not lead them to make such cells at all. The eggs and grubs simply lie about loose amongst the chambers of the ant-hill, instead of being confined in regular hexagonal cradles. Hence the bees' mode of honey-storing is practically impossible for them: they have not the groundwork habit from which it might be developed. But the ants have a crop, or first stomach, in which they store their undigested food, before passing it into the gizzard, exactly as in fowls. When ants come back from feeding, whether on flowers, on aphides, or on galls, their crops are very much distended; and they can bring back the food to their mouths from these distended crops, to supply the grubs and their other helpless dependents in the nest. If, therefore, some of the ants were largely to over-eat themselves, they would be able to feed an exceptionally large number of dependants.

Dr. McCook observed that some very greedy workers, returning to the nest, fastened themselves upon the roof in the same position as the honey-bearers, and in fact seemed gradually to grow into rotunds. The other ants would soon learn that such lazy, overgrown creatures were the best to go to for food; and, in time, these gorgers might easily become specialised into a honey-bearing set of insects. The workers would bring them honey, which they would store up and disgorge as needed for the benefit of the rest as a whole. If the honey passed into their gizzards and was digested, they would be a positive dead loss to the community, and so the tendency would soon be eliminated by natural selection, because the nests possessing such workers could not hold their own in bad times against neighbouring communities. But as only a very small quantity is ever digested—just as much as is necessary to keep up the sedentary life of such immovable fixtures—the effect is about the same as if the honey were stored in cells of wax. The ants, in fact, utilise the only good vessel or utensil they have at their disposal, the flexible and extensible abdomen of their own comrades.

The greatest difficulty is to understand how the workers first acquired the habit of feeding these lazy members to such repletion; but as all ants "take toll" of one another, this is much less of a crux than it looks at first sight. A very greedy ant, which not only ate much itself while out foraging, but also took toll of all others in the nest, after it was too full to move about readily, would be in a fair way to become a rotund. And as it would thus be performing a useful function for the rest, at the same time that it was gratifying its own epicurean tastes, the habit would soon become fixed and specialised, till at last we should get just such a regular and settled form of honey-storing as we see in this Colorado species. Indeed, another totally distinct type of ant in Australia has arrived at exactly the same device quite separately, as so often happens in nature under similar circumstances. Whatever benefits one creature under any given conditions will also benefit others whose conditions are identical; and thus we often get adaptive resemblances between plants and animals very widely removed from one another in genealogical order.

HOW TO RIDE A TRICYCLE.

By John Browning

(Treasurer of the London Tricycle Club).

THE greatest disadvantage the tricycle has to contend with is the supposition that anyone can ride it without learning. I have proved the reverse, to my own satisfaction, in the following simple manner:—I have driven a double tricycle with my wife by my side and fifty pounds of luggage behind us for twenty miles without fatigue, while I have ridden with a strong man less than eight miles on the same machine without luggage and been tired out. Yet my wife, on the occasion to which I refer, did not drive, but had her feet on the foot-rests, while the gentleman, being a very powerful man, was, I feel certain, exerting twice the strength I was using myself. There seems to me but one possible explanation of this—that riders without practice press down both feet together, pressing one foot down a little harder only than the other, instead of lifting up one foot and pressing down the other at the same time.

Again, tricycle riding brings muscles into action that are not used in walking, and these muscles require to be gradually strengthened by practice before either long rides or fast riding are attempted. Many persons having hired a machine, and driven it a few miles, have found it very hard work, and given up all idea of purchasing one. Beginners should restrict themselves for several weeks to riding from five to ten miles at a pace not exceeding six miles an hour.

I know one case in which a gentleman bought a tricycle, and against advice rode it home about ten miles. The next day he wrote to the agent and asked him to send for the machine and sell it for any price he could get for it. Another instance I was told of where a gentleman hired a tricycle in the north of London for a week, and paid for it, and started to ride to Portsmouth. In less than two hours he brought the machine back, and asked to return it and forfeit any amount of the payment he had made the maker pleased, adding that he had had enough of it.

Hills should never be attempted until the rider can ride well on the level. Considerable practice is required to ride hills without great fatigue. Time and strength are saved in the long run by dismounting as soon as the strain is felt to be at all severe. An exceptionally strong rider may soon succeed in riding up a tolerably steep hill, but he will waste strength which would have carried him at a greater pace or to a further distance if he had husbanded it by dismounting. After a few months' practice the rider will run up hills almost unconsciously which would at first have taxed him severely.

Next, as to riding down hill. Choose a machine with a break which is applied to *both* the driving wheels. When riding on the level or down a slight incline put on the break slowly, but firmly. If it acts efficiently it will bring the machine to a standstill without causing it to swerve to either side. Should it swerve round the rider should not attempt to descend a steep hill on it until the fault has been corrected, under the penalty of being thrown out by its turning over. The swerving is caused by one break acting on one tire more than the break on the other. Machines which drive both wheels by means of what is called a balance gearing from one chain are not liable to this serious fault.

In descending a hill on a tricycle with a trustworthy break, the feet should be taken off the pedals and planted firmly on the foot-rests, as the body is steadier, and the machine can be steered more accurately than when the legs are moving rapidly, and the legs are, of course, rested.

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The machine should not be steered to avoid loose stones when running down hill, the speed should be decreased, and the rider should go straight through them. A tricycle will turn in a much shorter space than a bicycle, but it should never be turned when running quickly. The speed should be reduced to about four or five miles an hour, and the rider should lean over in the direction towards which he wishes to turn.

The rule of taking the feet off the pedals when riding down hill will not apply to the Humber Tricycle. That machine throws a great strain on the arms as soon as the feet are taken off the pedals. The feet are, with practice, unconsciously used in steering, and after a time an expert rider can steer this machine without holding the handles.

Beginners will find it well not to pull hard at the handles of any tricycle continuously; but to use them scarcely at all when riding down an incline, only moderately when on a level road; and to reserve them principally for use when working on rising ground, when, from having been only occasionally used, they will be a powerful assistance. Their constant use will be found very fatiguing.

In all that I am saying I am supposing the rider wishes to travel as far as his strength will allow him, at a pace of about seven or eight miles an hour.

Should his only object be to ride at the top of his speed, he must almost stand on his pedals, lean well forward, and pull hard at the handles.

A strong rider, with practice, can ride at the rate of twelve miles an hour for two or three hours, and at the rate of ten miles an hour for four or five hours. The amateur champion, Mr. Lacy Hillier, has ridden fifty miles over an exceedingly hilly road in four hours, fourteen minutes.

I am often asked to state the comparative speed of bicycles and tricycles. I consider the tricycle is about two miles an hour slower than the bicycle. The remark is frequently made that the tricycle is much harder work than the bicycle. I reply, not at the relative speeds I have named. The tricycle has an immense advantage over the bicycle in being capable of adjustment to the strength of the person who is going to use it. A machine with driving-wheels 54 in. in diameter, geared level, would require a strong and practised rider to drive it up a moderate incline; but by replacing the lower wheel, which carries the chain, with a wheel from an inch to two inches smaller, the machine can be made to run so lightly that it may be driven easily—of course at a slower pace—up moderate inclines by a lady, or even by a child.

Tricycle riding is gaining ground more rapidly even than bicycling. The best makers of well-known machines cannot execute orders under about two months, and makers of one well-known Sociable (that is double tricycle) will not at present accept orders to be executed in a stipulated time. The cranks of double tricycles are made in two ways. In one construction the right foot of each driver rises and falls at the same time. In the other the right foot of one driver is half way up when the other is either up or down. This is called putting the crank on the quarter turn. The last arrangement is the best for hill-riding, but is not so convenient or efficient generally, as it gives the appearance and sensation of two scullers in a boat taking strokes alternately—a proceeding most ungraceful in appearance, and one by which strength is wasted.

The advantages of tricycles over bicycles are numerous and evident. They can be ridden at a slower pace than the bicycle, or stopped at any time, without dismounting, to admire a view, inspect a building, read the direction on a finger-post, or speak to a friend. They will carry almost any amount of luggage. A great many tricycles are now employed by the postmen in country districts for carrying letters and parcels. Policemen and lamplighters are also using them. Tricycling brings more muscles into play than walking, and is a more exhilarating exercise. To the healthy and strong it is even more exhilarating than horse-riding.

Our greatest authority on health, Dr. B. W. Richardson, F.R.S., recommends stout people to adopt it, and says that a very stout person will find that he can ride six miles with less fatigue than he can walk one.

I know many persons who have given up rowing after a short experience of tricyling, saying that the rush down a breezy hillside is more exciting and exhilarating than a row on either river or sea.

I consider that a tricycle-rider has almost as great an advantage over a walker as a rider in a railway train has over a rider in a coach. Where roads are fairly good, a tricyclist can cover six miles with less fatigue than a pedestrian can travel three. It is probable that the rapid increase of tricycling will, before long, cause a great improvement in our country roads. Were they made exceedingly good, ten miles an hour could be ridden on a geared-up or speeded tricycle (in which the wheels would turn round quicker than the cranks moved by the feet) easier than a pedestrian could walk four miles an hour.

The rapid improvement being made in double tricycles is inducing many bicyclists to adopt them who have not been tempted by the single tricycle. The weight of a double tricycle is much less than that of two single tricycles, and they can be ridden by two good riders at as great a pace as a bicycle. The enjoyment of riding one of these machines with a friend, particularly with a lady friend, must be tried before it can be fully appreciated.

THOUGHT-READING.

By the Editor.

DICKENS describes another feat which the conjuror performed, which, were it not that the first can only be explained as a feat of mind-ruling, we might explain as a trick merely of legerdemain and quickness of vision. But, under the actual conditions, it seems to indicate powers of mind-reading far more surprising than any ever noticed in parlour experiments. The conjuror "had several common school-slates about a foot square. He took one of them to a field-officer from the camp, *decoré* and what not, who sat about six from our seats, with a grave, saturnine friend next him. 'My General,' says he, 'will you write a name on this slate, after your friend has done so? Don't show it me.' The friend wrote a name, and the General wrote a name. The conjuror took the slate rapidly from the officer, threw it violently down on the ground with the written side to the floor, and asked the officer to put his foot on it and keep it there, which he did. The conjuror considered for about a minute, looking devilish hard at the General. 'My General,' says he, 'your friend wrote Dagobert upon the slate under your foot.' The friend admits it. 'And you, my General, wrote Nicholas.' General admits it, and everybody laughs and applauds. 'My General, will you excuse me, if I change that name into a name expressive of the power of a great nation, which, in happy alliance with the gallantry and spirit of France, will shake that name to its centre?' [This was in 1854.] 'Certainly, I will excuse it.' 'My General, take up the slate, and read.' General reads: 'Dagobert, Victoria.' The first in his friend's writing; the second in a new hand. I never saw anything in the least like this; or at all approaching to

the absolute certainty, the familiarity, quickness, absence of all machinery, and actual face-to-face, hand-to-hand fairness between the conjuror and the audience with which it was done."

It is clear that in this feat there was legerdemain, and (in a sense) machinery, too. Several common school slates were brought in, but one slate only was used. We may be sure this, however it resembled the others, was not, like them, a common school slate; and that the name, Victoria, was already written on it under the surface which was prepared to receive whatever name the General's friend might write. We might also explain the conjuror's knowledge of what the General and his friend had written, by the wonderful quickness and keenness of sight which conjurors obtain with constant practice. That some can tell what name is being written, by watching the movements of the pencil-end remote from the slate or paper, is certain. I am disposed, however, to consider this a case of mind-reading, after the much more wonderful case cited before, which can only be explained as an instance of mind-ruling. In the following cases it seems doubtful whether mind-reading or mind-guiding were in question. Prof. Barrett is referring to trials made with the children and a young servant-girl of the Rev. Mr. C., of whose personal integrity he was convinced (though, of course, this statement respecting a person unnamed must be taken only for what it is worth, that is, as an expression of opinion).

"Having selected at random one child, whom we desired to leave the room and wait at some distance, we would choose a card from a pack, or write on paper a number or a name which occurred to us at the moment. Before leaving the room the child had been informed of the general nature of the test we intended to select, as 'this will be a card,' or 'this will be a name.' On re-entering she stood—sometimes turned by us with her face to the wall, often with her eyes directed towards the ground, and usually close to us, and remote from her family—for a period of silence varying from a few seconds to a minute, till she called out to us some number, card, or whatever it might be. . . . . The first attempt was to state, without searching, the hiding-place of some small object, the place having been chosen by ourselves, with the full range of the house, and then communicated to the other members of the family. This was effected in one case only out of four. The next attempt was to give the name of some familiar object agreed on in the child's absence, as 'sponge,' 'pepper-caster,' &c. This was successful on a first trial in six cases out of fourteen. We then chose a card from a full pack in the child's absence, and called upon her to name it on her return. This was successful at once in six cases out of thirteen. . . . . A harder trial was now introduced. The maid-servant having left the room, one of us wrote down the name 'Michael Davitt,' showed it round, and then put the paper in his pocket. The door was now opened, and the girl recalled from the end of the passage. She stood close to the door amid absolute silence, and with her eyes on the ground—all of us meanwhile fixing our attention on the appointed name—and gave after a few seconds the name 'Michael,' and then almost immediately 'Davitt.' To avoid any association of ideas, we then chose imaginary names, made up by ourselves at the moment, as 'Samuel Morris,' 'John Thomas Parker,' 'Phœbe Wilson.' The names were given correctly *in toto*, at the first trial in five cases out of ten. Three cases were complete failures, and in two the names given bore a strong resemblance to those selected by us, 'Jacob Williams,' being given as 'Jacob Wild,' and 'Emily Walker,' as ''Enry Walker.' It was now getting late, and both we and the younger children were very tired; and four concluding attempts to guess the name of a town in England were all failures, though one of us had previously obtained remarkable success in this very experiment."

It appears to me that the failures in these and other cases yet to be cited, are as important a part of the evidence in favour of mind-reading or mind-ruling, as the successes. For they tend to show that there was no general system of deception by which the members of the family who had been present when the names were selected informed the children by signals previously agreed upon. However, as it will be obvious that there can be no absolute certainty on this point in cases in which any members of the family knew what was selected, we proceed to consider cases in which only the committee of investigation knew the words or things chosen.

(To be continued.)

HOW TO GET STRONG.

WE have received, through the Editor, a great number of communications, with which we propose to deal consecutively before passing to the consideration of other exercises for the expansion and development of the chest.

Several correspondents ask about the instrument called an inspirometer, which is mentioned in a quotation from an American work. We must trust to American readers to answer this question; for we have not ourselves seen or used this instrument. The breathing test, used at various places of amusement, though on a different principle, serves the same purpose when properly used. Very few people seem to know how to use this instrument. The Editor writes to us as follows, very much to the point, on this subject:—"Have you ever noticed what very poor records most persons make with the breathing apparatus, compared with what they *can* make when they go to work properly? You will see a well-built man, standing some six feet in his stockings, who, advancing to the instrument, will begin to blow, watching the index with a look as if he would send it round to 400 at least, yet will barely mark 200; yet there is nothing wrong with the big fellow's lungs, as from such a record for such a height one might judge. Tell him *how to do it*, and he will send the index well over 300. I have watched a score of men who ought to reach 250, averaging not more than 150. Then I have taken the tube, and though below the middle height, and too fleshy for full breathing, have sent the index on beyond 200 to 250, to 300 (till people began to ask whether I was breathing out of my boots), and on to 340 or 350—the greatest I have reached being 353. Then one or two have asked me, apart, how the thing was done, and I have explained that before ex-spiring, the breath is to be drawn in till you can draw in no more, and every atom of air so drawn in is to be let out steadily through the tube, none escaping beforehand. I have then seen a man who had just, with utmost efforts, reached 180, go easily above 300."

Speaking of fleshiness, it should be added to the usual instructions respecting the use of the breathing apparatus, that any addition to the weight beyond that due to fair condition, is certain to affect the record with the breathing apparatus.

Several correspondents ask our opinion of various exercises, as rowing, riding, walking, tricycling, boxing, cricket, &c. It will probably sound paradoxical, after the stress we have laid on the necessity for exercise, to say that we consider each one of these exercises, *as pursued by*

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specialists, undeniably bad for the development of a well-proportioned and thoroughly healthy frame. Take, for instance, any first-class eleven at cricket; select, if you please, an eleven such as the Australian, in which all-round aptitude is a characteristic feature, and you will invariably find so large a proportion of ill-shaped men as to show that thoroughly well-built cricketers owe their goodly proportions to exercises outside cricket. Despite the running involved in the game, four cricketers out of five have badly-developed chests. One would say a good bat should have good shoulders, but that batting does not tend to improve the shoulders is shown by two, at least, of the finest Australian bats. Take rowing, again. Unless a rowing man does other work especially intended to correct the defect, he has invariably poor arms above the elbow, a marked inferiority in the development of the chest as compared with the back, and he generally has round shoulders and a forward hang of the head and neck. Boxing is better, but it cannot be pursued with advantage as the chief exercise a man or boy takes, and it is entirely unsuited to girls and women (for whom we write, by-the-way, quite as much as for boys and men, though for girls our calf-skin dumb-boxer may not be the best of all chest-opening exercises).

In answer to many inquiries, we note that Mr. Blackie's work, "How to Get Strong," is published by Harper & Brothers, New York. We do not know the price. Much of its contents are specially intended for American readers. Maclaren's little book (not on Dumb-bells, as some readers seem to suppose, but on Training), is published by Messrs. Macmillan.

Other correspondents ask us what weight dumb-bells should be for persons of given height and weight. Every one who uses dumb-bells should have them of different weights for different exercises. There are some chest exercises for dumb-bells which would tax the strength too much if the dumb-bells weighed more than two pounds each (these would be wooden), while for exercises in putting up weight, the dumb-bells should weigh from six pounds each to ten pounds each. It is better to have them too light than too heavy, unless the person using them is going in for athletic honours; but we are not writing for such persons.

Clubs have several uses for which dumb-bells are not available, especially for exercise in wrist play. We are asked by some of what shape they should be, and where to be purchased. We thought every one knew the ordinary shapes of Indian clubs,—straight handle, with a knob to prevent the club slipping out of the hand and spindle-shaped heavier part, in plain or polished wood. Any wood-turner would make a pair for a few shillings, and would require no other instructions but "Indian clubs of such and such weight each." The clubs ought not to be heavy. Five pound clubs (that is ten pounds weight the pair) will serve men strong enough to *wield* clubs of twice or thrice their weight; in fact, many flourish about heavy clubs and sway heavy dumb-bells with apparent ease, but really to their own detriment; for to support the strain of heavy clubs or dumb-bells, the chest assumes a constricted attitude, just as it does in very hard rowing, and in several other exercises which men pursue under the impression that they are improving their development.

The effect of constant hard work in special directions may best be judged by noticing porters, coal-heavers, and the like away from their ordinary employment. They do their work so well, that one would say they were very powerful men, and so in a way they are. But they cannot walk freely; nay, some of them can scarcely stand upright.

(To be continued.)

HOME CURES FOR POISONS.

ANTIMONY.

ANTIMONY and its compounds would not be dangerous were it not for the too prevalent opinion that they may be used in all cases, safely, as emetics. Antimony itself cannot be used in this way until it has been so modified by chemical admixture as to be capable of decomposition by the fluids of the body. For this purpose tartarised antimony, in the form commonly known as *tartar emetic* (the double tartrate of potash and antimony) is usually employed; and most cases of antimonial poisoning have arisen from the administration of tartar emetic in large doses. The employment of this substance to detect children or servants who have taken forbidden articles of food has led to some very sad cases of poisoning. The practice cannot be too strongly reprehended. Tartar emetic has also been used, as foolishly, to cure confirmed drunkards of their bad habit, by causing sickness. The latest case in which the use of antimony as a poison, with criminal intent, was suspected, was the so-called Balham tragedy. The case was very difficult to understand, but very instructive. It may be remembered that Mr. Bravo had bought a quantity of tartar emetic for the purpose of dosing Mrs. Bravo's wine, so that she might be cured, if possible, of her tendency to drink it in undue quantities. After a quarrel he had gone to his room, and soon after began to suffer severely from what eventually proved to be the effects of antimonial poisoning. He lingered in great pain for two or three days, and during that time nothing transpired to suggest that he had been wilfully poisoned. After his death the body was examined, and it was unmistakably shown that death was caused by antimonial poisoning. Mrs. Bravo was suspected of having murdered her husband, the idea being that a medical friend of hers had suggested to her the use of tartar emetic to poison Mr. Bravo. The whole theory of those who suspected Mrs. Bravo was absurd on the face of it, and, probably, but for the horror which the supposed crime excited, the case would have been quickly closed; but it was continued until the cruelty of the cross-examination to which Mrs. Bravo was subjected excited the pity of many who had had very little sympathy for her at the outset. But the difficulty was to understand how, in reality, the poison had been administered or taken. Mr. Bravo was well acquainted with the general properties of tartar emetic, and knew that in large doses the substance is poisonous. He could hardly have taken it by accident, or have taken more than a sufficient emetic dose, if he had proposed to use it in that way medicinally. The only theory which at all corresponded with the evidence was one which illustrates one of the characteristic properties of this substance. Mr. Bravo had threatened to commit suicide, and had bought laudanum with the avowed purpose of using it to kill himself. Persons who talk in this way very seldom do commit suicide; but it seems likely that after the quarrel referred to above, in the course of which he had repeated the threat, Mr. Bravo did take a poisonous dose of laudanum,—trusting, we believe, to the tartar emetic in his possession as a safe and sure emetic by which to get rid of the laudanum, when it had served his purpose. But it so happens that while tartar emetic is very certain in its emetic action in nearly every case (being surpassed only in this respect by sulphate of zinc), it should never be taken in cases of narcotic poisoning, for in large doses tartar emetic is itself a poison unless the stomach quickly rejects it, and narcotic poisons so diminish the sensibility of the

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stomach that it will retain under their action what, under other conditions, it would immediately reject. Any one unaware of this, who had taken a dose of tartar emetic to cause vomiting after a narcotic had been swallowed in poisonous or almost poisonous quantity, would be apt to repeat the dose, especially if ignorant of the quantitative poisonous properties of antimony. This, in all probability, was what Mr. Bravo did, until he had taken a poisonous amount of that substance by which he had hoped to get rid of the laudanum he had taken in excess. It was a noteworthy feature of the case that even when his anguish was at its greatest, he would not take laudanum for its relief.

Be this theory correct or not (for our own part, we have no doubt of its correctness, for the simple reason that every other is in some one or other respect absurdly inconsistent with the known facts of the case), it is well to know that tartar emetic is not suitable in cases of poisoning, though very proper, under medical advice, in other cases where an emetic is required.

REMEDIES.

When tartar emetic has been taken in poisonous amount, and vomiting does not follow, it must be excited until, if possible, all the poison has been rejected. Copious draughts of tepid water, tickling the back of the throat, and other such methods of producing vomiting may be employed. If, however, the poison cannot be got rid of in this way, a decoction of tincture of quinine may be given with advantage, for tartarised antimony is decomposed by nearly all bitter or astringent vegetables which contain tannin, producing an inert tannate of the protoxide of antimony (which is the active base of tartar emetic and James's Powder). Should no quinine be at hand, a strong infusion of black tea should be administered, pending the arrival of a medical man.

THE AMATEUR ELECTRICIAN.

ELECTRIC GENERATORS (*continued*).

WE will now leave our magneto machine in the hands of our readers for a time. Possibly their own ingenuity may suggest one or two modifications. One that will reward the extra labour and care involved is, winding the armature with two wires side by side simultaneously, so that there will be four ends to deal with. By a simple contrivance the two coils may then be used at pleasure for intensity or quantity—that is to say, we may join them up so as to become one continuous coil, or we may connect the two internal ends together, likewise the two external ends. This latter course is practically doubling the size of the wire. The first arrangement would produce comparatively a current of high electro-motive force and small quantity, the second a current of low electro-motive force but large quantity.

The next step that we may notice in apparatus of this kind is the introduction of electro-magnets in place of the ordinary steel magnets. These may consist of broad, flat pieces of iron, like those in the Siemens or Brush dynamo machines (that is to say, the width extending the whole length of the pole-pieces); or of a series of iron rods enveloped with wire, as in the Weston machine. Doubtless, but few have seen this machine, but they will not go far wrong if they adopt the flat form, winding the iron with No. 18 or 20 cotton-covered wire. Wilde is credited with introducing this form of machine. He used a small machine with permanent magnets to produce the current for magnetising the electro-magnet, and thus obtained in the armature actuated by this electro-magnet a very considerable current. A small battery will serve the same purpose. The smaller machine or battery is generally known as an "Exciter." Its function is apparent. It must be remembered that the polarity of the electro-magnets must be on the same principle as that which applies to the use of permanent magnets; that is to say, the wire must be wound so as to induce north magnetism in one pole-piece and south in the other. It will be advisable to use four flat plates 4 in. by, say, 6 in., and ¼ in. thick, joining the pairs of free or external ends together by means of iron plates.

The next discovery was one of vital importance. Those who have had any experience with electro-magnets, even on so small a scale as are used in telegraph instruments, will be aware that, however soft a piece of iron may be, it is almost certain to retain, for a greater or less time, a small amount of magnetism. This is called remanent, or residual magnetism, and Siemens and Wheatstone (simultaneously but separately) found it sufficiently strong to enable them, by an ingenious arrangement, to dispense with the exciting current. It is easily accomplished by the amateur. Join one of the brushes to one of the electro-magnets (or field magnets), allowing the current to pass thence through the other magnet, and out to one of the terminals. The other brush is connected to the other terminal as usual. What takes place is this:—First, there is a small amount of magnetism in the field magnets; this induces in the armature a small current, which, being made to pass through the field magnet increases the inducing effect. The increased armature current also passes through the field magnet, and so on and on, continually increasing until a very powerful current is obtained.

This brings us to the end of our descriptions of simple forms of generators. Before we can go any farther, we must devote three, or perhaps four, articles to a brief account of the various methods of measuring electric currents, and of the units adopted in so measuring, never forgetting, however, that we are writing for amateurs.

THE TELEPHONE IN FRANCE.—M. Cochery, the French Minister of Posts and Telegraphs, has asked the Chamber for a grant of 250,000 f. to enable him to establish a State telephonic service between certain towns in France.

AN ELECTRIC TRAMWAY.—The Portrush and Bushnels Electric Tramway, near Belfast, the first that has been constructed in the United Kingdom, will be opened in the first week in August. The ceremony will probably be performed by the Lord-Lieutenant.

INTERNATIONAL TELEGRAPH STATISTICS.—According to statistics recently issued, the length of wires in the various countries is as follows:—Germany, 159,910 miles; Russia, 134,465 miles; France, 125,265 miles; Great Britain, 121,720 miles; Austria-Hungary, 89,960 miles; Italy, 53,692 miles; Sweden and Norway, 28,445 miles; Belgium, 16,345 miles, and Switzerland, 10,010 miles. The total numbers of messages sent during the past year are classed as follows:—England, 29,820,445; France, 19,882,628; Germany, 16,312,457; Austria-Hungary, 8,729,321; Russia, 7,298,422; Italy, 6,511,497; Holland, 3,109,230; and Sweden and Norway, 2,028,805.

THE following should have formed part of the first paragraph on p. 63:—The conclusions arrived at by the sub-committee are, 1st.—The maximum efficiency of incandescent lamps in the present state of the subject, and within the experimental limits of this investigation, cannot be assumed to exceed 300 candle-lights per horse-power of current. 2nd.—The economy of all lamps of this kind is greater at high than at low incandescence. 3rd.—The economy of light-production is greater in high resistance lamps than in those of low resistance, thus agreeing with the economy of distribution. 4th.—The relative efficiency of the four lamps examined, expressed in Carcel burners of 7·4 spermaceti candles each, produced by one horse-power of current, is as follows:—(A.) At 16 candles: Edison, 26·5; Swan, 24; Lane-Fox, 23·5; and Maxim, 20·4. (B.) At 32 candles: Edison, 41·5; Lane-Fox, 37·4; Swan, 35·5; and Maxim, 32·4. To double the light given by these lamps the current-energy was increased, for the Maxim and Lane-Fox lamps, 26 per cent.; for the Edison lamp, 28 per cent.; and for the Swan lamp, 37 per cent.

ELECTROMANIA.

BY W. MATTIEU WILLIAMS.

A HISTORY of electricity, in order to be complete, must include two distinct and very different subjects: the history of electrical science, and a history of electrical exaggerations and delusions. The progress of the first has been followed by a crop of the second from the time when Kleist, Muschenbroek, and Cuneus endeavoured to bottle the supposed fluid, and in the course of these attempts stumbled upon the "Leyden Jar."

Dr. Lieberkuhn, of Berlin, describes the startling results which he obtained, or imagined, "when a nail or a piece of brass wire is put into a small apothecary's phial and electrified." He says that "if, while it is electrifying, I put my finger or a piece of gold which I hold in my hand to the nail, I receive a shock which stuns my arms and shoulders." At about the same date (the middle of the last century), Muschenbroek stated, in a letter to Réaumur, that, on taking a shock from a thin glass bowl, "he felt himself struck in his arms, shoulders, and breast, so that he lost his breath, and was two days before he recovered from the effects of the blow and the terror"; and that he "would not take a second shock for the kingdom of France." From the description of the apparatus, it is evident that this dreadful shock was no stronger than many of us have taken scores of times for fun, and have given to our schoolfellows when we became the proud possessors of our first electrical machine.

Conjurors, mountebanks, itinerant quacks, and other adventurers operated throughout Europe, and were found at every country fair and *fête* displaying the wonders of the invisible agent by giving shocks and professing to cure all imaginable ailments.

Then came the discoveries of Galvani and Volta, followed by the demonstrations of Galvani's nephew Aldini, whereby dead animals were made to display the movements of life, not only by the electr'city of the voltaic pile, but, as Aldini especially showed, by a transfer of the mysterious agency from one animal to another.

According to his experiments (that seem to be forgotten by modern electricians) the galvanometer of the period, a prepared frog, could be made to kick by connecting its nerve and muscle with muscle and nerve of a recently killed ox, with or without metallic intervention.

Thus arose the dogma which still survives in the advertisements of electrical quacks, that "electricity is life," and the possibility of reviving the dead was believed by many. Executed criminals were in active demand; their bodies were expeditiously transferred from the gallows or scaffold to the operating table, and their dead limbs were made to struggle and plunge, their eyeballs to roll, and their features to perpetrate the most horrible contortions by connecting nerves with one pole, and muscles with the opposite pole of a battery.

The heart was made to beat, and many men of eminence supposed that if this could be combined with artificial respiration, and kept up for awhile, the victim of the hangman might be restored, provided the neck was not broken. Curious tales were loudly whispered concerning gentle hangings and strange doings at Dr. Brookes's, in Leicester-square, and at the Hunterian Museum, in Windmill-street, now flourishing as "The Café de l'Étoile." When a child, I lived about midway between these celebrated schools of practical anatomy, and well remember the tales of horror that were recounted concerning them. When Bishop and Williams (no relation to the writer) were hanged for burking, *i.e.*, murdering people in order to provide "subjects" for dissection, their bodies were sent to Windmill-street, and the popular notion was that, being old and faithful servants of the doctors, they were galvanised to life, and again set up in their old business.

It is amusing to read some of the treatises on medical galvanism that were published at about this period, and contrast their positive statements of cures effected and results anticipated with the position now attained by electricity as a curative agent.

Then came the brilliant discoveries of Faraday, Ampere, &c., demonstrating the relations between electricity and magnetism, and immediately following them a multitude of patents for electro-motors, and wild dreams of superseding steam-engines by magneto-electric machinery.

The following, which I copy from *The Penny Mechanic*, of June 10, 1837, is curious, and very instructive to those who think of investing in any of the electric power companies of to-day:—"Mr. Thomas Davenport, a Vermont blacksmith, has discovered a mode of applying magnetic and electro-magnetic power, which we have good ground for believing will be of immense importance to the world." This announcement is followed by reference to Professor Silliman's *American Journal of Science and the Arts*, for April, 1837, and extracts from American papers, of which the following is a specimen:—"1. We saw a small cylindrical battery, about nine inches in length, three or four in diameter, produce a magnetic power of about 300 lb., and which, therefore, we could not move with our utmost strength. 2. We saw a small wheel, five-and-a-half inches in diameter, performing more than 600 revolutions in a minute, and lift a weight of 24 lb. one foot per minute, from the power of a battery of still smaller dimensions. 3. We saw a model of a locomotive engine travelling on a circular railroad with immense velocity, and rapidly ascending an inclined plane of far greater elevation than any hitherto ascended by steam-power. And these and various other experiments which we saw, convinced us of the truth of the opinion expressed by Professors Silliman, Renwick, and others, that the power of machinery may be increased from this source beyond any assignable limit. It is computed by these learned men that a circular galvanic battery about 3 ft. in diameter, with magnets of a proportionable surface, would produce at least a hundred-horse power; and therefore that two such batteries would be sufficient to propel ships of the largest class across the Atlantic. The only materials required to generate and continue this power for such a voyage would be a few thin sheets of copper and zinc, and a few gallons of mineral water."

The Faure Accumulator is but a very weak affair compared with this, Sir William Thompson notwithstanding. To render the date of the above fully appreciable, I may note that three months later the magazine from which it is quoted was illustrated with a picture of the London and Birmingham Railway Station displaying a first-class passenger with a box seat on the roof of the carriage, and followed by an account of the trip to Boxmoor, the first instalment of the London and North-Western Railway. It tells us that, "the time of starting having arrived, the doors of the carriages are closed, and, by the assistance of the conductors, the train is moved on a short distance towards the first bridge, where it is met by an engine, which conducts it up the inclined plane as far as Chalk Farm. Between the canal and this spot stands the station-house for the engines; here, also, are fixed the engines which are to be employed in drawing the carriages up the inclined plane from Euston-square, by a rope upwards of a mile in length, the cost of which was upwards of £400." After describing the next change of engines, in the same matter of course way as the changing of stage-coach horses, the narrative proceeds to say that "entering the tunnel from broad daylight to perfect darkness has an exceedingly novel effect."

I make these parallel quotations for the benefit of those who imagine that electricity is making such vastly greater strides than other sources of power. I well remember making this journey to Boxmoor, and four or five years later travelling on a circular electro-magnetic railway. Comparing that electric railway with those now exhibiting, and comparing the Boxmoor trip with the present work of the London and North-Western Railway, I have no hesitation in affirming that the rate of progress in electro-locomotion during the last forty years has been far smaller than that of steam.

The leading fallacy which is urging the electro-maniacs of the present time to their ruinous investments is the idea that electro-motors are novelties, and that electric-lighting is in its infancy; while gas-lighting is regarded as an old, or mature middle-aged business, and therefore we are to expect a marvellous growth of the infant and no further progress of the adult.

These excited speculators do not appear to be aware of the fact that electric-lighting is older than gas-lighting; that Sir Humphry Davy exhibited the electric light in Albemarle-street, while London was still dimly lighted by oil-lamps, and long before gas-lighting was attempted anywhere. The lamp used by Sir Humphry Davy at the Royal Institution, at the beginning of the present century, was an arrangement of two carbon pencils, between which was formed the "electric arc" by the intensely-vivid incandescence and combustion of the particles of carbon passing between the solid carbon electrodes. The light exhibited by Davy was incomparably more brilliant than anything that has been lately shown either in London, or Paris, or at Sydenham. His arc was *four inches in length*, the carbon pencils were four inches apart, and a broad, dazzling arch of light bridged the whole space between. The modern arc lights are but pigmies, mere specs, compared with this; a leap of ½ or ¼ inch constituting their maximum achievement.

Comparing the actual progress of gas and electric lighting, the gas has achieved by far the greater strides; and this is the case even when we compare very recent progress.

The improvements connected with gas-making have been steadily progressive; scarcely a year has passed from the date of Murdoch's efforts to the present time, without some or many decided steps having been made. The progress of electric-lighting has been a series of spasmodic leaps, backward as well as forward.

As an example of stepping backward, I may refer to what the newspapers have described as the "discoveries" of Mr. Edison, or the use of an incandescent wire, or stick, or sheet of platinum, or

platino-iridium; or a thread of carbon, of which the "Swan" and other modern lights are rival modifications.

As far back as 1846 I was engaged in making apparatus and experiments for the purpose of turning to practical account "King's patent electric light," the actual inventor of which was a young American, named Starr, who died in 1847, when about 25 years of age, a victim of overwork and disappointment in his efforts to perfect this invention and a magneto-electric machine, intended to supply the power in accordance with some of the "latest improvements" of 1881 and 1882.

I had a share in this venture, and was very enthusiastic until after I had become practically acquainted with the subject. We had no difficulty in obtaining a splendid and perfectly steady light, better than any that are shown at the Crystal Palace.

We used platinum, and alloys of platinum and iridium, abandoned them as Edison did more than thirty years later, and then tried a multitude of forms of carbon, including that which constitutes the last "discovery" of Mr. Edison, viz., burnt cane. Starr tried this on theoretical grounds, because cane being coated with silica, he predicted that by charring it we should obtain a more compact stick or thread, as the fusion of the silica would hold the carbon particles together. He finally abandoned this and all the rest in favour of the hard deposit of carbon which lines the inside of gas-retorts, some specimens of which we found to be so hard that we required a lapidary's wheel to cut them into the thin sticks.

Our final wick was a piece of this of square section, and about $\frac{1}{8}$ of an inch across each way. It was mounted between two forceps —one holding each end, and thus leaving a clear half-inch between. The forceps were soldered to platinum wires, one of which passed upwards through the top of the barometer tube, expanded into a lamp glass at its upper part. This wire was sealed to the glass as it passed through. The lower wire passed down the middle of the tube.

The tube was filled with mercury and inverted over a cup of mercury. Being 30 in. long up to the bottom of the expanded portion, or lamp globe, the mercury fell below this and left a Torricellian vacuum there. One pole of the battery, or dynamo-machine, was connected with the mercury in the cup, and the other with the upper wire. The stick of carbon glowed brilliantly, and with perfect steadiness.

I subsequently exhibited this apparatus in the Town-hall of Birmingham, and many times at the Midland Institute. The only scientific difficulty connected with this arrangement was that due to a slight volatilisation of the carbon, and its deposition as a brown film upon the lamp glass; but this difficulty is not insuperable.

A SURGEON'S TOOLS—CLEAN OR UNCLEAN?

I HAVE told you one story out of our shop. Here is a second, true as the first, quite.

The great master of British surgery, Sir Rusty Poyntz, and the smaller (I'm not going, sir, to say smallest), which was your humble servant, met in consultation over a very sad and touching case. It was that of a young Eton lad, a fellow of keen eye, deft hands, and extra bright brains. His grand family house in a huge Belgravian square was but a golden cage for that handsome, sweet-voiced skylark; and, lark-like, he pressed his little heart against the golden bars—now singing, now sighing for the blue air, the flashing rivers, the shout of the cricketers, the hum of the nine hundred—save one—this one! It was a case of abdominal dropsy; and that were a hard, a hardest, heart which did not ache when the bedclothes were put aside, and the great, wax-like, tumid trunk disclosed to view, full to distension. It was to be tapped.

As we went up the grand stairway, Sir Rusty Poyntz opened his pocket-case of tools, and picked out one adapted for that operation. Mr. Smaller asked to look at it—previous experience having taught him that Sir R. P.'s tools wanted a little looking to. Sure enough, it was so now. The tool is called a trochar, and consists of a split tube, the canula fitting over a piecing, triangular, tapering, and pointed end. The tube is slipped down until it falls with a spring click into a groove, thus keeping the edge of the tube under cover of the shoulder of the stem, as the instrument is thrust into the body. This done, the stem is withdrawn, leaving the canula behind to form a conduit, through which the imprisoned liquid of the dropsy rushes out. When in fine order, a more beautiful, simple, painless instrument does not exist. But if the tapering point be dulled, its sides rusted, and the edge of the canula unprotected, it were hard to find a more torturing instrument. And now, reader, hearken: that was the state of the tool in question, and that cruel, cruel thing, was to be thrust through the tender skin and tissues of a sensitive and nervous boy, dull at its point, rust-coated down its sides.

It was just that which I had expected, and I showed the defective instrument to the great surgeon. He had none better, and the operation being of pressing importance, there was not time to procure another. "It don't signify, you know," said the "Great"; "But it is a cruelly hurtful instrument in its present state," said the "Smaller." Halting a little, I got some of the rust off, and I slightly sharpened the cutting point and edges. How I longed for my lovely Turkish stone and its persuasive oil. Well, the savage tool rent its ragged way, and the brave lad, pulling himself together —for you must remember that skinny, weazened little fellow had a hero's gallant blood in him—and with a few half-stifled groans, and one long-drawn sigh, the thing was done. A surprising quantity of fluid rushed through the canula, the lad found immense relief and ease of breath, and, with all of a boy's elasticity, in an hour or two he lay smiling on his couch, his cunning fingers hard at work toy-making—the cruel hurt, the operation, and the Big and the Little Surgeon "alike forgot."

But these things ought not so to be, and what is worse—rather is better—they need not to be so—for the suffering might not have been inflicted, had Sir R. P. only imitated that wise and celebrated boar, who used to keep his weapons always keen for service. Besides, who in this day of small things—the air pregnant with the beginnings of life—the earth steaming forth and the waters laden with the potentialities for evil—who, I say, can tell but that the unclean surfaces of a surgeon's weapons may not (I believe they do) poison the tissues through which they are thrust. Reader, despise not, thou, these prophesyings, and if by evil fortune thou needest the surgeon, make Sir Rusty Poyntz see to his blade. Why, there is one of our craft, a canny Scot is he, who not only keeps a cutting edge on his instruments, but actually dips the keen blade into a "germ"-slaying solution before ever he lays open the million little mouths beneath the skin. I, myself, over and over again, after washing my cut surfaces with zinc chloride solution (weak), have pressed them together again, varnishing the wound with a film of blood, and then covering it over with a thick layer of cotton wool (the filtration-power of which is now known to every one), and exercising a masterly inactivity for a week or ten days, I have then gently taken off the wool, with the sure joy of finding the ugly gash healed from end to end. I cut out a hideous cancer from a lady's breast, making one single cut more than 10 in. long, and so treating it, found it strongly knit together throughout in eight days. For why? Because I cut with the very keenest of edges—thus not tearing up the tender tissues, and also because no "germ" of mischief could pass through my armour of cotton wool.

Here's a lot of sack, Mr. Learned Editor, but I must have my pennyworth of bread also devoured—and an important mouthful it is. I had great searchings of thought concerning my little sufferer, and the cruel instrument used; and on this wise—What is the figure of least resistance to the dissevering part? Does it vary with the nature of the substance to be severed, or is it similar in all cases? and in the case of human skin, muscle, and other tissues of the body, what shape of instrument passes through most easily? I earnestly seek a reply; and on no other page than that of KNOWLEDGE could I have the chance of obtaining an answer. And—now 'tis your turn to blush, sir—of no other man in England could I hope for a right, well-reasoned, and well-demonstrated reply as of you. I have made a good many human "cuts" in my surgeon's life; and, like another more distinguished gentleman in the art of shedding blood, I have earned my diploma. "He must shed much more blood, and become worse to make his title good." But I have always tried to operate as painlessly as I knew how. Pray, if it be possible, come over and help us and our followers; and can the inquiry be offered thus for solution?

Query: What is the mathematical form (I mean *shape*) of least resistance; say in the instance of a tool (as in this case) which has —first, to penetrate, and second, to bisect a body composed of skin overlying muscle or other forms of tissue? When that is answered, the answer-giver will have the pleasure to know that he will save a mass of human suffering if we succeed in getting our instrument-makers to adopt the formula. He has invented another crumb: be not crusty over it, I pray. Please inform your twenty thousand readers that the astute, sympathetic, and skilful Mr. Smaller has, for some time past, left the field of the battle for life, and is now a non-combatant. Thus, sir, you perceive I may now, without treading on anybody's toes or wounding their delicate susceptibilities, sit on my little perch and crow, or more appropriately chant, the coming sunrise in, with "healing in His wings." ROBERT ELLIS.

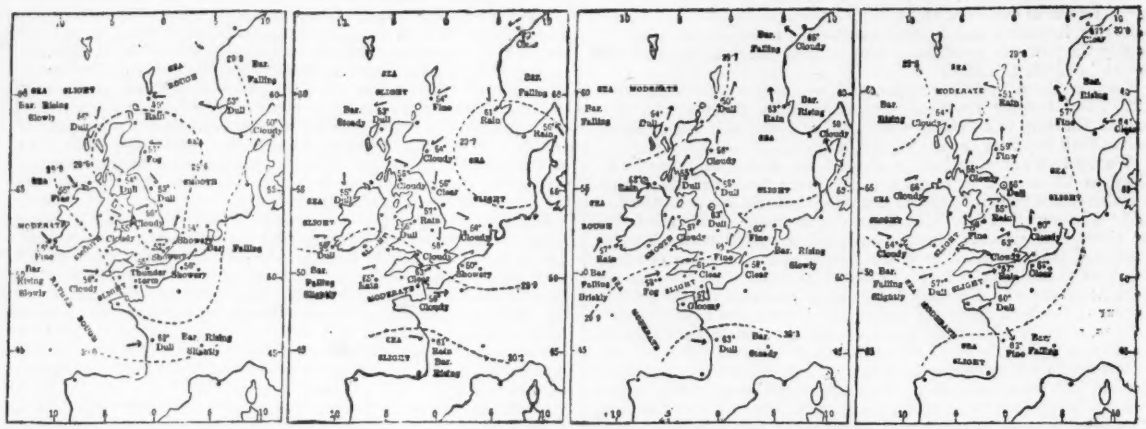
Raven Spring, Mitcham.

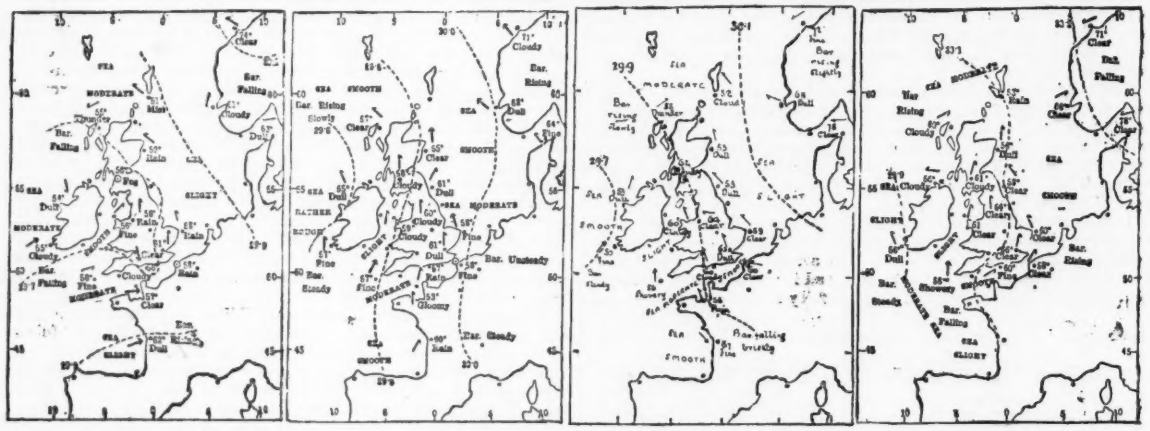
FIRE CAUSED BY LIGHTNING.—The poor-house in the small town of Oesthamman, in Sweden, was set on fire by lightning and burnt to the ground on June 1. Out of fifty-two inmates, twenty perished in the flames.

XUM

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JUNE 25.

SUNDAY, 18TH. MONDAY, 19TH. TUESDAY, 20TH. WEDNESDAY, 21ST.





THURSDAY, 22ND. FRIDAY, 23RD. SATURDAY, 24TH. SUNDAY, 25TH.

In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶ light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

IT is stated that within the last few months a representative of the Chicago, Milwaukee, and St. Paul Railway has purchased in England about 20,000*l*. worth of machinery for the new carriage shops of the company.

SOME old bricks having been observed to affect the compass-needle by Herr Kepner, at Salzburg, in the Tyrol, he then had two bricks made from each of eight varieties of clay in the neighbourhood, one brick in each case being baked. The unbaked bricks did not affect the needle, but seven of the eight baked bricks proved polarly magnetic. Some further experiments have been made by Herren Kell and Trientl. Particles of powder of the magnetic bricks adhered to a steel magnet. Breunerite, mica-slate, argillaceous iron-garnet, chlorite, and hornblende were, before heating, unmagnetic, but intense heating produced a magnetic polarity, the axis of which seemed to be perpendicular to the plane of stratification.

IN a recent lecture on some of the dangerous properties of dusts, Professor Abel, F.R.S., said that many experiments were tried with sensitive coal-dust from Seaham and other collieries for the purpose of ascertaining whether results could be obtained supporting the view that coal-dust, in the complete absence of fire-damp, is susceptible of originating explosions and of carrying them on indefinitely, as suggested by some observers; but, although decided evidence was obtained that coal-dust, when thickly suspended in the air, will be inflamed in the immediate vicinity of a large body of flame projected into it, and will sometimes carry on the flame to some small extent, no experimental results furnished by these experiments warranted the conclusion that a coal-mine explosion could be originated and carried on to any considerable distance in the complete absence of fire-damp. Some experiments made in a large military gallery at Chatham showed that the flame of a blown-out shot of 1¼ lb. or 2 lb. of powder might extend to a maximum distance of 20 ft., while in a very narrow gallery, similar to a drift-way in a mine, the flame from corresponding charges extended to a maximum distance of 35 ft. These distances are considerably inferior to those which flame from blown-out shots has been known to extend, with destructive results, in coal-mines, and there appears no doubt that, in the latter cases, of which the lecturer gave examples, the flame was enlarged and prolonged by the dust raised by the concussion of the explosion. But in the presence of only very small quantities of fire-damp, dust may establish and propagate violent explosions; and that, in the case of a fire-damp explosion, the dust not only, in most instances, greatly aggravates the burning action and increases the quantity of after-damp, but that it may also, by being raised and swept along by the blast of an explosion, carry the fire into workings where no fire-damp exists, and thus add considerably to the magnitude of the disaster.

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STARS FOR JULY

OUR STAR MAP.—The circular boundary of the map represents the horizon. The map shows also the position of the Equator and of that portion of the Zodiac now most favourably situated for observation. The names of ninety-nine stars of the first three magnitudes are given below.

On June 30, at 10·30 p.m.
On July 3, at 10·15 p.m.
On July 7, at 10· 0 p.m.
On July 11, at 9·45 p.m.
On July 14, at 9·30 p.m.
On July 18, at 9.15 p.m.
On July 22, at 9· 0 p.m.

ARABIC NAMES OF STARS.

The following table exhibits the names of all the stars of the first three magnitudes whose names are in common use:—

α Andromedæ	...	*Alpheratz*
β ———	...	*Mirach, Mizar*
γ ———	...	*Almach*
α Aquarii	...	*Sadalmelik*
β ———	...	*Sadalsund*
δ ———	...	*Skat*
α Aquilæ	...	*Altair*
β ———	...	*Alshain*
γ ———	...	*Tarazed*
α Arietis	...	*Hamal*
β ———	...	*Sheratan*
γ ———	...	*Mesartim*
α Aurigæ	...	*Capella*
β ———	...	*Menkalinan*
α Boötis	...	*Arcturus*
β ———	...	*Nekkar*
ε ———	...	*Izar, Mizar, Mirach*
η ———	...	*Muphrid*
α Canum Venat.	...	*Cor Caroli*
α Canis Majoris	...	*Sirius*
β ———	...	*Mirzam*
ε ———	...	*Adara*
α Canis Minoris	...	*Procyon*
β ———	...	*Gomeisa*
α^2 Capricorni	...	*Secunda Giedi*
δ ———	...	*Deneb Algiedi*

α	Cassiopeiæ	Schedar
β	———	Chaph
α	Cephei	Alderamin
β	———	Alphirk
γ	———	Errai
α	Ceti	Menkar
β	———	Diphda
ζ	———	Baten Kaitos
ο	———	Mira
α	Columbæ	Phact
α	Coronæ Borealis	Alphecca
α	Corvi	Alchiba
δ	———	Algores
α	Crateris	Alkes
α	Cygni	Arided, Deneb Adige
β	———	Albireo
α	Draconis	Thuban
β	———	Alwaid
γ	———	Etanin
β	Eridani	Cursa
γ	———	Zaurac
α	Geminorum	Castor
β	———	Pollux
ζ	———	Alhena
δ	———	Wasat
ε	———	Mebsuta
α	Herculis	Ras Algethi
β	———	Korneforos
α	Hydræ	Alphard, Cor Hydræ
α	Leonis	Regulus, Cor Leonis
β	———	Deneb Aleet, Denebol
γ	———	Algeiba
δ	———	Zosma
α	Leporis	Arneb
α	Libræ	Zuben el Genubi
β	———	Zuben el Chamali
γ	———	Zuben Hakrabi
α	Lyræ	Vega
β	———	Sheliak
γ	———	Sulaphat
α	Ophiuchi	Ras Alhague
β	———	Cebalrai
α	Orionis	Betelgeux
β	———	Rigel
γ	———	Bellatrix
δ	———	Mintaka
ε	———	Alnilam
α	Pegasi	Markab
β	———	Scheat
γ	———	Algenib
ε	———	Enif
ζ	———	Homan
α	Persei	Mirfak
β	———	Algol
α	Piscis Australis	Fomalhaut
ε	Sagittarii	Kaus Australis
α	Scorpionis	Antares, Cor Scorpionis
α	Serpentis	Unukalhai
α	Tauri	Aldebaran
β	———	Nath
η	———	Alcyone (Pleiad)
α	Ursæ Majoris	Dubhe
β	———	Merak
γ	———	Phecda
ε	———	Alioth
ζ	———	Mizar
η	———	Alkaid, Benetnasch
ι	———	Talitha
α	Ursæ Minoris	Polaris
β	———	Kochab
α	Virginis	Spica Azimech, Spica
β	———	Zavijava
	———	Vindemiatrix

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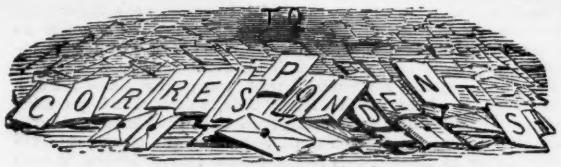

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Letters which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

THE LATE MR. DUNMAN.

WE should be obliged if "J. L. W." would forward his address to Mr. Litchfield, whose address is given at the foot of a letter respecting the late Mr. Dunman on p. 28 of KNOWLEDGE, No. 32. —EDITOR.

TOBACCO AND CONSUMPTION.

[442]—The narration of a piece of personal experience may not form a wholly valueless contribution to the discussion of the connection between smoking and an immunity from consumption. I may thankfully say that the solitary complaint from which I ever suffer is relaxed (or "gravelly") sore throat; and this only attacks me if I am exposed to cold or wet. If, however, under such circumstances, I take a cigar, it acts as an absolute prophylactic, apparently by drying up the mucous membrane. It is fair to add that I often do not smoke for weeks at a time. It is quite possible that, were I an habitual smoker, the very valuable effect of which I have spoken might cease to accrue. As it is, to go out into the rain without my cigar means an infallible sore throat; to "light up" as a preliminary step, assured freedom from it. W. N.

[443]—The question of a possible connection between tobacco and consumption has been raised by a correspondent. Does tobacco smoking prevent or cure consumption? This question is one of mournful interest to many English families, and it is one which we have some means of answering; for although we are, in common with most civilised nations, a tobacco-loving people, it is at present only the adult male portion that so indulges. If, then, it has any influence over the disease, we should expect to find the benefit so derived confined to men. Let us see what statistics have to teach us on this point.

Dr. Boudin gives the following figures ("Traité de Géographie et des Statistique Médicales," tome ii., p. 643, 1857):—"In England and Wales, in the year 1838, 27,935 males and 31,090 females died of consumption; 1839, 28,106 males and 31,453 females; (with the exception of London) 1842, 24,048 males and 28,098 females.

The fifth annual report of the Registrar-General (p. 398) gives the following death-rate by phthisis (consumption), in 1841, in the twenty-five large towns, comprising 1,883,693 inhabitants, and in seven counties having 1,700,434 inhabitants:—In the towns, 4,279 males and 4,427 females; in the counties, 2,886 males and 3,540 females. The general death-rate from consumptive diseases was in 1848, 31,573 males and 32,502 females; in 1851, 32,278 males and 33,746 females. "These figures," Mons. Boudin goes on to say, "are far from indicating a predominance of consumptive affections amongst women, if one remembers that in nearly all the European countries the number of women exceeds that of men."

Dr. P. C. A. Louis records ("Researches on Phthisis," translated by Dr. Walshe, p. 479. 1844), a series of 123 cases, analysed and collected in wards containing 48 beds, equally divided between individuals of both sexes, 70 of which were furnished by females, and 57 by males. Dr. Louis in order to ascertain, if possible, the influence of sex on the mean duration of the disease, says (p. 377):—"I compared two series of individuals, one of them comprising 97 women, and the other 113 men. I found that the mean duration had been twenty months in the women and seventeen in the men—a rather considerable difference, and one of the reverse kind from that which might have been expected, inasmuch as phthisis being more common in females than males, it might naturally have been supposed that the sex most strongly predisposing to the disease would also have hastened its progress."

There is nothing in these figures, then, to show that men derive any benefit in the way of preventing or retarding consumption by the use of tobacco. And if we now turn to some other statistics, we shall find that the belief that women are more subject to consumption than men is not universal.

Dr. A. B. Shepherd (Gulstonian lecture on the Natural History of Pulmonary Consumption, 1877), gives a table of 849 cases of ordinary phthisis (consumption) observed at the Victoria Park Hospital. Of these, 465 were males and 384 females. At the Lyons hospitals for this disease in 1873 were admitted 860 males and 569 females, or a proportion of the former to the latter of three to two. There is nothing very conclusive about these figures—the preponderance of male cases over female is probably due to the harder work and exposure that is oftener the lot of men than women—although this must to some extent be counterbalanced by the baneful confinement of the female lower orders, from morning to night, in squalid dens and poisoned alleys. But be that as it may, there is nothing to show that tobacco has the slightest preventive or curative power over consumption.

May the day soon arrive when medical science shall discover a cure for consumption. We have much to cause us to look confidently forward into the future; and although unwise legislation, the result of specious humanitarianism, has checked the advancing tide of knowledge in England, yet men like Pasteur in France and Koch in Germany, unhindered by a paternal Government, are making discoveries that shall redound to their glory as long as the heart has woes, as long as this world shall last.

W. M. BEAUMONT, M.R.C.S., Oxford.

[444]—I have read with interest Mr. W. B. Wicken's letter (No. 411, p. 630) on Tobacco and Consumption, as also Mr. Prosser's reply thereto (No. 418, p. 28, Vol. II).

Smoking tobacco as a cure for consumption, I am afraid, will never come to the fore. Climate has, I hold, a great deal to do with the prevalence or scarcity of this disease, for we find that it is most met with in moist temperate countries, like Great Britain, and is comparatively scarce in countries which suffer the extreme of heat and cold.

But another reason for the prevalence of consumption in this country (and in others) is the habit that human beings have acquired of breathing through their mouths, and not through their nasal organs. The air we breath through the mouth goes down to the lungs unpurified, while that breathed through the nose is deprived of obnoxious matter (with which the air is always more or less filled), that organ having the property of purifying the air breathed, as well as others. Mr. Prosser, in his letter, gives an example of this. He says that tobacco smoke has undoubtedly a soothing effect, for when his laboratory is filled with acid fumes, he has no inclination to cough, as long as he uses his pipe. It is not the soothing effect of the tobacco fumes that prevents his inclination to cough, but, while he has the pipe in his mouth, he necessarily breathes through his nose, and the air is purified (so far at least) before it reaches the lungs, and causes no irritation. There are many races of Indians who still possess this natural practice, and were it reacquired in this country, I do not doubt that consumption and other diseases of the lungs would become comparatively things of the past. W. HUME.

TURKISH TOBACCO.

[445]—Your correspondent, in letter 418, is a little bit out in regard to the tobacco used by the Turks for the hookah nargileh. The tobacco used, and I have smoked much of it (yet cannot stand half a pipe of the mildest tobacco used in England), is called

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"tunbeki"—Persian tobacco. It is either very mild, or else the process it undergoes, before reaching the lungs of the smoker, robs it of much of its strength. Before being placed in the nargileh it is moistened, and then the moisture squeezed forcibly from it. Let Mr. Prosser try to smoke the English forms of tobacco—to wit, shag, birdseye, returns, gold leaf, &c., &c.—in a nargileh, and he will alter his opinion as to to the "tunbeki" of Constantinople; but then he only took "one puff." Another case of neglected opportunities! He missed the chance of making the acquaintance of a smoke which does not depress you, after which you have no desire to drink, and to which the lower class of Turks owe their fortitude under difficulties, their suavity of manner, and temperance in all things.

A CONSTANT READER.

THE FEVER TREE.

[446]—Mr. Southall, writing of the *Eucalyptus Globulus*, seems to think it has not yet been acclimatised in Europe. Perhaps I may be allowed to say that it grows luxuriantly all along the Riviera, and more particularly in the neighbourhood of Cannes, and if acclimatisation consists in bearing flowers and fruit in the open air, it is certainly there acclimatised, for I have seen there trees from sixty to one hundred feet high, perfectly *loaded* with the bluish fruit, or more correctly seed-vessels, from which a pointed capsule is thrown off by the magnificent crown of white stamens and pistils which form the flower (there being, I believe, no petals). The seeds contained in the hard, woody case, are numerous and extremely minute, much smaller than a grain of mustard seed, and it seems difficult to imagine a tree—such as one I saw, a perfect giant, growing in the gardens of the Duc de Vallambrosa, where it had been planted only in (I believe) 1865—having sprung from such a seed.

The people of the south of France are greatly impressed with its efficacy in fever and rheumatism, for which latter disease they wear branches laid over the part affected, and you never mention the tree to a peasant without hearing: "Ah, it is very good for the fever." The manufacturers of Cannes use it largely in soaps and perfumes, and one preparation, a toilet vinegar, is the most exquisitely perfumed and refreshing thing of the kind I have ever met with. It seems a pity our chemists do not make more use of a tree which has many capabilities, both as a febrifuge and a healthy and refreshing perfume.

A. W. BUCKLAND.

GLASS STYLOGRAPHS.

[447]—Will "H. L. C." (letter 424, p. 28, No. 32, Vol. II.) be good enough to enlighten your readers as to the way he makes his glass-tube pens (if not a trade secret) and oblige many others as well as this

WRITER.

PROBABILITIES.

[448]—The remarks of "N." (401) having passed without comment, and fearing they may induce a belief in the advantage of a system of increasing or decreasing stakes, I wish to contribute my mite to dispel such an illusion in as few words as I possibly can. If a die be thrown a finite number of times, and any one stake his money so as to gain a given sum per throw, and retrieve losses on unsuccessful throws, provided the gamester's resources are unlimited, it is evident that n trials ending with a successful throw will yield $n\ m$ (or m per trial), and this will happen whatever odds may be laid! But if the speculator is not possessed of unlimited resources, there is no advantage in varying the stake in any way. If a single die be thrown *ad infinitum*, the number of times the die is unsuccessfully thrown on the second trial in proportion to the number of unsuccessful throws on the first trial, will be as five to six; the number of unsuccessful throws on the third trial, will bear the same proportion to the number of unsuccessful throws on the second trial, and so on. The number of times the die is thrown successfully in proportion to the number of unsuccessful throws on any trial will be always as one to five, the chance of throwing a die successfully always being the same, irrespective of how many times it may have been thrown successfully or unsuccessfully previously. Any succession of successful or unsuccessful throws is no guide to what may follow, notwithstanding the fact that the proportion of successful to unsuccessful throws will ultimately assume the proportion of one to five. When a die is thrown a finite number of times, the greater the number of throws, the nearer will the result approach the theoretical numbers; for this reason, in throwing a die, the first time it is thrown successfully, the die will only once have been thrown on that particular trial, and that once successfully; if we continue to throw the die, the ratio between the successful and unsuccessful throws on that particular trial will assume the proportion of one to five, and the one successful throw on one particular trial will be farther removed, and the more times the die is thrown, the farther removed from the first trial will be that trial in which each throw (one or more) is successful. There is another increasing stake to which the above remarks apply, viz., to win a given sum together with past losses, so that if an event happen n times in m trials ending with a successful trial, you gain n times the sum you sought to win on the first trial. This is exemplified by tossing a penny, and doubling your stake each time you lose, reverting to the original stake after each win. Supposing the resources of the gamester to be infinite, this is the lowest rate of increment from which any advantage can be gained. There would be no advantage in seeking to gain a given sum together with half the losses since the last successful trial. In games of skill and chance the most skilful player must ultimately win, as he is bound to get his share of the luck, and it is to his advantage to increase the stakes at the commencement of any fresh game, whether he has been gaining or losing previously. In playing any game of pure chance, there can be no advantage from increasing the stakes after a loss or a succession of losses; if the odds are against you, you must lose; the higher the stakes, the more you lose in proportion. Under any circumstances there is no advantage in following any system of increasing or decreasing stakes, or of investing so as to secure an increasing amount of money either after a loss or after a gain. No system has yet been or ever will be devised that will convert certain loss into certain gain. If you cannot gain by making the stakes equal, you cannot by making them unequal.

THOMAS JOBSON.

Bromley, Kent, *June* 15, 1882.

SPECTACLES.

[449]—Suppose you give us an article upon spectacles when convenient. A short time since I bought from a country dealer a pair of suitable focus, 30 inches, and capital frame. They were by a celebrated maker, and marked by him as "pebbles." Their nominal focus proved to be exact, each lens gave a neat solar image at precisely the assigned distance, but on testing them between two nicol prisms, I found no change of light or colour, such as is expected from quartz in polarised light.

Having a favourable opportunity, I submitted the spectacles for the several opinions of three practical opticians in London. The first said the polish was apparently too perfect for glass; but placing on a table before the window a pile of common window glass, eight or ten pieces, perhaps, about 6 inches square—a polarizing bundle in fact—he held a tourmaline before the eye with one hand, and a lens of the spectacles in the other in the line of sight between the tourmaline and the plates, and at once pronounced the material to be glass and not quartz. The second referee produced a pair of tourmaline tongs, and placing a spectacle lens between them, gave the same verdict. He showed how, when the tourmalines were "crossed," the rotation of a "pebble" lens between them restored the light at certain intervals; whereas the introduction of a glass lens produced no effect whatever. The test of the third was simpler still: he touched a lens of the spectacles with the tip of his tongue, and said it was "not cold enough for pebbles," remarking that this was the advantage possessed by quartz lenses—they were cooler to the eyes.

Now, is there anything in this? Does the question of specific heat really arise? or is the advantage only that of superior hardness, as compared with glass, and consequent less liability to scratching?

Then, too, supposing it to be conceded that quartz is the better material, is anything gained by employing sections cut at a certain angle with the axis of the crystal, as is maintained by at least one London optician? Another, of equal eminence, asserts that provided the quartz be pure, free from striæ and bubbles, and uniform in density, you may cut it into slices for spectacle lenses where and how you like.

Certainly the various appearances which are presented in the polariscope by quartz crystals, according as they are cut parallel to, at right angles, or at different angles with the axis, may indicate that it is not immaterial to the lens of the eye, what section of the crystal be taken. But on the other hand, the eye does not often use polarized light with spectacles.

T. S. B.

THE FIFTEEN SCHOOLGIRLS.

[450]—The best way that I can think of to manage this problem is the following. Designate the girls by the letter C and the numbers 1 to 14. Let one group for the first day's arrangement be C 1, 2, and set the numbers 3, 5, 9 as the first members of three other groups. With 3 join any other odd number (not already used), and an even number, which must be, with 7, 6, or 10; with 11, 8, or 14; with 13, 6, or 12. With 5 join numbers formed from those with ?,

by doubling the odd number and subtracting 1 or 15, and doubling the even number and substracting 2 or 16. With 9 join numbers formed in the same way from those with 5. This will complete four groups, and the fifth group will consist of the remaining numbers, either 4, 6, 10, or 8, 12, 14.

Make the second day's arrangement by adding 2 to every number in the first day's, except 13 and 14, from which you must subtract 12. Make each day's arrangement from that of the preceding day in the same way, and the problem is solved.

Any solution may be varied by making the odd and even numbers change places—that is, each odd number changing places with the next greater even number.

The explanation of this solution is that in the first day's arrangement one odd number is combined with another differing from it by 2, one with another differing from it by 4 or 10, and one with another differing from it by 6 or 8; and it is the same with the even numbers. Also the combinations of odd and even numbers are such that one odd number is combined with an even number 1 greater, one with an even number 3 greater,

one with an even number 5 greater or 9 less,
" " " 7 " 7 "
" " " 9 " 5 "
" " " 11 " 3 "
" " " 1 less.

These differences are not changed by the successive additions of 2, except by changing a difference to what we may call its complement, as $+d$ to $+d-14$. The place of every number in the first day's arrangement will in the course of the six following days be occupied by every other number of the same class (odd or even as the case may be), and consequently every number will, in the course of the seven days be once joined with C, and once with a number differing from it by each possible difference, whether the difference be added or subtracted.

This method is applicable with slight modifications to most other schoolgirl problems, where the number of the girls is $12n+3$, and not otherwise; but in some cases, and as I have particularly noticed in cases of $60n-9$ girls, there are difficulties in the way of applying it which I do not know any simple way of getting over. For better illustration of the method of solving other problems, I add one solution of the problem of thirty-nine schoolgirls.

Make a series of odd numbers beginning with 3, by doubling each term and subtracting 1 or 39 to form the next, and set the series down in pairs thus:—

3	5	8
9	17	26
33	27	22
15	29	6
19	37	18
35	31	28
23	7	30
13	25	38
11	21	32
4	10	34
16	20	36
24	14	12

With each of these pairs join the even number which is the sum of the two numbers composing the pair, deducting 38 if greater than 38. These numbers are the same as the even terms in the series of odd numbers, each increased by 1. Now take the odd terms in that series in order, add 1 to each, and set them down in threes, as is here done.

These sets of three, with the addition of $C, 1, 2$, form the arrangement for the first day, from which the arrangements for the other days are formed by successive additions of 2 or subtractions of 36.

ALGERNON BRAY.

MISPLACED SPA.

[451]—The efflorescence mentioned by "Curiosity" has been found by chemical analysis to vary considerably in composition. It often consists of sulphate of magnesia, also sulphate of lime, of carbonate sulphate, or nitrate of soda, of chloride of soda and potash, and carbonate of potash. It is attributable sometimes to the bricks or stones of a wall, sometimes to the mortar.

In bricks burnt with coal fires or made from clay containing iron pyrites the sulphur from the fuel converts the lime or magnesia in the clay into sulphates. When the bricks are wet these dissolve; when dry they evaporate, leaving crystals on the surface. Many limestones contain magnesia; these are acted upon during calcination by the sulphur in the fuel; sulphates are formed which find their way into the mortar and produce the efflorescence mentioned. Again, the sulphur acids evolved from ordinary house fires attack the magnesia and lime in the mortar joints of chimneys; these dissolve and evaporate on the surface. The formation of chlorides is nearly sure to take place if sea sand or sea water be used, or in bricks made from clay which has been covered by salt water.

"Prevention is better than cure."

The best plan is to avoid all the materials above mentioned as likely to give rise to efflorescence, in the case of bricks; clay containing pyrites or much magnesia should not be used; special bricks may be burnt with coke or wood.

As regards mortar, the use of limestones containing magnesia to any great extent may generally be avoided. If, however, it does occur, in spite of all precautions, the following remedies may be tried:—

In the case of ashlar work, the surface may be covered with a wash of powdered stone, sand, and water, which is afterwards cleaned off. This fills up the pores of the stone, and temporarily stops the efflorescence. When the wash is removed the efflorescence will recommence, but in a weaker degree than before.

Painting the surface is sometimes efficacious if it is done before the efflorescence commences.

The mortar before use may be treated, to prevent it from causing efflorescence by mixing with it any animal matter.

W. H. PERTWEE.

EXTINGUISHING CANDLE-FLAME.

[452]—I do not know whether it has ever come under your notice that an ordinary wax candle may be blown out without leaving any red-hot snuff. If the candle be drawn backwards so that the flame envelopes the wick right to the end, the burning of the latter is quenched, for the obvious reason that it is in the heart of the flame where no air can reach it, and a sudden puff at this juncture puts out the flame and wick too. The proper direction to blow in is that of the tangent to the curve of the wick from the end of the latter; in fact, the experiment can, with care, be made to succeed without moving the candle at all, if attention be paid to this point.

I have also noticed that the third envelope of a candle-flame can be made distinctly visible by burning a little sodium in the neighbourhood of the flame, so that, from being faintly blue, it becomes tinged with yellow, and can be seen, in spite of the luminous layer inside it.

C. L. BARNES.

SECTIONS OF A CONE.

[453]—In drinking a glass of water, as the glass is sloped towards the lips the surface assumes an elliptical form. It has struck me that since it was thus possible to obtain a section of a cylinder, a somewhat similar contrivance might be used for demonstrating the figures commonly known as "sections of a cone." My idea is simply this—to make a hollow glass cone, and partially fill it with any tinted liquid. By giving it different degrees of inclination, the surface of the liquid might be made to assume the form of any conic section, from the circle to the hyperbola. Further, if the apparatus were so arranged that the liquid occupied exactly half the capacity of the hollow cone, we could obtain the limiting form of two straight lines, by holding the cone so that its axis should be horizontal. I think the advantages of this system are many and obvious. First, it would be cheaper than the wooden sections now in use, which require delicate workmanship; secondly, it would have the advantages of compactness and completeness, and would run no danger of being lost piecemeal; and, lastly, the demonstrator, by a motion of the hand, could actually show the ellipse in the process of passing off into either of its two limiting forms—namely, the circle or the parabola—and thus attract the attention and interest of the pupil.

GEORGE E. CRAWFORD.

AMONGST the coming electrical exhibitions, that to be held at Munich in the autumn will be of especial interest, as it is the intention of the authorities to use, as the driving-power for the dynamo-machines, the water-force of the river Isar, estimated at 3,000 horse-power, and to prove that it is possible to make use of it to light, at a distance of some miles the streets and houses, and to distribute the force to the different workshops.

PRICES OF BOOKS.—The following very sensible paragraph appears among the answers to correspondents, in our valuable contemporary, the *School Board Chronicle*:—"'Educationist' writes: 'I should be much obliged if you would add the *price* of the books you so excellently review,' observing that 'they may be sixpence or a guinea, and no one can tell.'—We have had from time to time many communications from our readers in various parts of the country to the same effect. We can only say that it would give us great pleasure to afford this information to our readers, but we owe also some consideration to the proprietors of the *School Board Chronicle*, who naturally consider it to be the duty of the publishers of the books to inform the public through our advertising columns of the prices of the books which we review. In a large proportion of cases this information will be found among our advertisements, but not necessarily in the same week in which the review appears. We think publishers would consult their own interest by announcing the prices of the books immediately after the appearance of the reviews."

Answers to Correspondents.

*** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of KNOWLEDGE, the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—1. *No questions asking for scientific information can be answered through the post.* 2. *Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries.* 3. *Correspondents should write on one side only of the paper, and put drawings on a separate leaf.* 4. *Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

JAS. DEAS. On re-reading, your letter seemed not to contain the direct positive evidence necessary to make such cases scientifically useful.—W. H. BUTCHART. Mr. W. Mattieu Williams has not yet published his promised work on "Comets and Nebulæ."—R. SHEWARD. I fear it is hardly in favour of your theory of solar energy that it is "distinct and separate from any known." I do not remember any true theory of which this could be said. At present, however, my chief difficulty is that the theory could not be condensed into less than ten pages of KNOWLEDGE. Perhaps, if you published it elsewhere, we might manage to give the essence of it in less space.—E. D. G. We agree with you that Col. Ross's definition of analogy is incorrect. As in mathematics, "Analogy or proportion is the similitude of ratios," so in general anology signifies the similitude of relations, not resemblance between things.—A. MCLEAN. Many thanks. Your suggestions are all excellent. I proposed such a publication to one of the principal publishers of Victoria; but his idea was that it would hardly pay. If readers of KNOWLEDGE would not object to a series of maps doing for the southern hemisphere what those now publishing do for the northern, that would be a convenient way of producing the work. I think many, though living in the northern hemisphere, might like well to know the aspect of the constellations in the southern skies.—C. L. B. Let A B C be any triangle; P, Q, R, the centres of equilateral triangles on A B, B C, A C. Through A, draw a straight line parallel to P R, meeting the circles circumscribing the equilateral triangles on A B, A C, in c and b respectively. Thus it is obvious that b B and c C produced must meet on the circle circumscribing the equilateral triangle on B C (since the angles at b and c are each one-third of two right angles). The triangle $a\,b\,c$ is equiangular, and, therefore, equilateral. But $b\,c$ being the greatest chord which can be drawn through A to the circles b, c, it follows that $b\,a$ and $c\,a$ are also maximum chords. (For if longer chords could be drawn through B and C, their extremities would give an equilateral triangle circumscribing A B C, greater than $a\,b\,c$, or $b\,c$ would *not* be a maximum chord.) Hence $b\,a$ and $c\,a$ must be parallel to P Q and R Q. (For it can easily be seen that the maximum chord drawn, as $b\,a$ is drawn is parallel to the line joining the centres P and Q.) Hence the sides of the triangle P Q R, are parallel to those of the triangle $a\,b\,c$, or P Q R like $a\,b\,c$ is equiangular, and therefore is equilateral also.—CONSTANT READER. Your query seems in some way to have gone astray. We certainly put it in our box to forward to the writer of electrical articles, but suppose it was not sent.—BRITANNICUS. Would not the effect of the Saturday artillery practice be to produce heavy rainfall on Saturday and Sunday, if at all? Is there any evidence of a heavier average for these days? Again, the rainfall would be limited locally. Is there any evidence to show that there is this local effect? That under particular atmospheric conditions heavy cannonading may be followed by rainfall may be true enough; but "all great battles by land and sea" have not been followed by heavy rains within twenty-four hours.—F. N. NEWCOME. We might be able to find space for an occasional short article on subjects connected with India, China, or Burmah, if having a scientific bearing. Occasional notes on actuarial matters would also be welcome.—S. MIDDLETON. We have forwarded your obliging communication to Mr. Haviland, who is now in your town. —TRUTHFUL. We may shortly have something to say on bicycles, but for *health*-exercise the best use that can be made of a bicycle is to exchange it for a good, light-running tricycle. Bicycle-riding must be regarded as the bold and clever achievement of a difficult and hurtful feat. Consider the cramped, awkward, chest-compressing attitude of the most skilful bicyclists in riding, and note how they walk, and you will see that their exercise cannot be good for them.—W. S. BROOK. Many thanks for your kindly and encouraging letter. In part of our last issue the final result of the Vienna Tournament was given. As we went to press before the final round was over, you can understand that the first copies could not have it.—LORESMITH. Your answer to your question 2 is quite correct. As to the other question, the thing to be proved is not true unless n does not exceed a in a certain degree. For instance, the integral part of $(\sqrt{a^2+1}+a)^n$ is even when $a=1$ and $n=10$; I make it 67260. So, again, when $a=2$ and $n=10$, the integral part of the expressions is even—namely, 186050. Your reply to Pyramus's question is not clear to me. Why should there be an increase of 480 each year, when it is obvious that after a few years more than 12 will get their advance?—ED. P. TOY. No conjuror who valued his repute would trust to a person choosing "a lion" for animal, and "a rose" for flower; as you say, 80 out of 100 would, even if that proportion really held. But I have asked many the question you suggest, and I find a much greater number say "horse" and "dog" than "lion," and though "rose" has a slight preference over other flowers, "daisy," "buttercup," and "heartsease," are chosen nearly as often, while "pink," "wallflower," "violet," and "primrose," are not far behind. I should say about a tenth choose "rose," leaving the other nine-tenths for all the other flowers; but certainly not so many as one-twentieth select "lion." Supposing the chance one-tenth that a rose would be selected by anyone taken at random, and one-twentieth that a lion would be selected, the chance that both would be selected is one-two-hundredth, or there would be 199 failures to one success. Taking even your numbers—80 out of 100 for each—the chance of both being selected would be 6,400 ten-thousandths, or there would on the average be thirty-six failures in 100 trials—far too many to leave a conjuror a shred of reputation.—J. W. D. CHURCHILL. Thanks; but I doubt whether so many take interest in the matter as you think.

ELECTRICAL.

A. NEAL. 1. The lamp is constructed after Swan's design, but may be only a catch-penny. Light is emitted by all parts of the filament proper, but sometimes the connecting copper or platinum wires extend some distance into the bulb. Apparently so in your lamp. You can increase the candle-power by increasing the current. 2. Ruhmkorff induction coils can be procured at all prices, from 13s. or 14s. upwards. 3. We intend writing on secondary batteries immediately.—P. C. F. The statement that, in driving a dynamo by steam the HP is in inverse ratio to R, although at first sight paradoxical, is quite correct when only E and R are given. HP is proportional to EC, that is, is proportional to C, E being fixed; but C is inversely proportional to R, therefore HP is also in inverse ratio to R. If C and R are taken, then, of course, HP is directly proportional to R, C being constant, because E increases at the same rate that R does. Taking $C^2R=\frac{E^2}{R}=CE$, whichever of these identities is used, the result is the same. Virtually, C and E are the only quantities from which HP can be obtained. Inasmuch, however, as C and E are associated with R in the manner expressed by Ohm's Law $\left(C=\frac{E}{R}\right)$; knowing any two of these three quantities, we can readily ascertain the third. To simplify matters, suppose we use a generator of low internal R, and whose E is 50 volts, to maintain incandescent lamps arranged in multiple arc. Then, if each lamp offers, say 25 ohms, the current through each will be 2 ampères. Manifestly, the H P developed will be directly as the number of lamps, but the R will be inversely proportional (from the law of parallel circuits). Joining the lamps in series will compel us to increase the E as each lamp is added. C being kept constant, the H P will be directly proportional to the R in the circuit. But in each case $\frac{EC}{746}=H\ P.$ By taking several of numerical examples, and working them out, identical results will be arrived at.—ALEXANDER HOWELL. The colouration of phosphoric acid, when dropped on your induction coil, was not due to electrical action, but in all probability was the result of the chemical action of the acid on the organic colouring matter used for dyeing the silk or whatever else may be the substance of the insulating material.

THE TELESCOPE.

COMET.—"Portable Equatorial" is a vague term—so vague, in fact, that we cannot give a definite answer to your question without you describe your form of mounting. In order to get at the Polar region of the sky, your telescope ought to be mounted at one end of the declination axis, being counterpoised by the declination circle and a weight at the other. Of course, every equatorial stand (to be used as such) must be a fixture, its Polar axis remaining, under all circumstances, parallel to that of the earth. If you will be a little more explicit in your description, we will try to help you.—J. W. COULBORN. No ordinary two-inch telescope will bear a higher power than 160, and it must be a very good one to perform well with such an amount of amplification. In order to obtain this power on your own instrument, you will require a Huyghenian eyepiece, whereof the focus of the field-lens is 0·35 inch, and that of

the eye-lens 0·11 inch. These lenses must be placed 0·23 inch apart with, we need scarcely add, their plane sides towards the eye of the observer.—LANCASHIRE will find that selenography will supply him with work at once interesting and useful. The study of the Solar surface, too, may be pursued with an instrument of the size of his, and the addition to it of a Browning's Star spectroscope will enable him to see something of the spectra of the prominences on the solar limb, to say nothing of its use in Stellar spectroscopy. Should he possess artistic taste, and be able to sketch, careful drawings of such planets as Mars, Jupiter, and Saturn, if made at intervals, possess a direct scientific value. His best plan, however, will be to purchase forthwith Webb's admirable "Celestial Objects for Common Telescopes," which is in reality a pocket Encyclopædia for the amateur observer.—EXCELSIOR. δ Herculis, as viewed on the meridian, with an ordinary inverting eye-piece, now presents the appearance of a large star, with a very much smaller companion almost horizontally to the left of it. We have not a copy of "Half Hours" at hand; but certainly no such change as your diagrams indicate has taken place in this star. Its position angle has varied some 22° during the last eighty-two years. Prior to the year 1871, the comes was below a horizontal line to the left of its primary; now it is just above such a line. We do not know upon what authority Castor is described as a ternary system in Nollwyn's "Astronomy." At any rate, no sensible change has taken place in the relative position or distance of the principal star and the 11′ magnitude one since the year 1823; and the system is universally regarded among astronomers as being simply binary, the minute star having obviously no physical connection with the well-known pair. With reference to Pollux, the word "coarse" was used as expressive of the considerable distance of the comites; "fine," as referring to their minute size. When Pollux is on the meridian on a dark night, you may pick these two companions up, both to the right, and a little below a horizontal line passing through their primary. The larger star of the two is about half as far again from Pollux as the smaller one. This last will require some looking for; though, when caught, it may be held steadily enough in a good three-inch telescope. The earliest recorded position of comet Wells is on March 19·6894, 1882, G.M.T.; when it was situated in R.A. 17° 54′ 38·1″, and declination 33° 25′ 5″ N. (which possibly ought to be 33° 24′ 5″ N.).

LONG DISTANCE TELEPHONING.—Recent experiments have been made with M. van Rysselberghe's system of telephony, during which messsages were sent by telephone over a long distance simultaneously with telegraphic messages traversing the same wire. The first experiment was made on an ordinary telegraph wire 353 kilomètres long, between Paris and Nancy; and the second between Paris and Brussels, over a wire 344 kilomètres long. It is stated that telephonic messages were distinctly heard, whilst the telegraphic messages were distinctly rendered by the Morse instruments employed. M. van Rysselberghe is the head of the Meteorological Observatory at Brussels.

ELECTRIC LIGHT IN THE CITY.—At a meeting of the Commissioners of Sewers, an abstract of the engineers' report was submitted, from which it appears that the cost for twelve months, including the fixing of machinery, lamps, &c., ranges, in district No. 1, from £2,190 to £5,750, as against the present cost of gas, £551; district No. 2, from £2,350 to £4,270, as against £363 for gas; district No. 3, from £2,470 to £3,800, as against £341 for gas; district No. 4, from £2,920 to £4,350, as against £612 for gas. Some of the companies couple with their tender a request to be allowed to light private premises within the district, and in that case the company offer to make the charge for lighting, irrespective of the machinery, &c., the same as for the gas saved plus 20 per cent. These figures show a great disparity when compared with other contracts.

THE ELECTRIC LIGHT AT CHESTERFIELD.—The bill for the public lighting of the streets of Chesterfield since November 1 last, when Messrs. Hammond & Co. undertook to illuminate the thoroughfares of the town by means of electricity, has been received by the Corporation. The period it covers is nearly five months, and the total amount charged £272. During a great part of that time there have been twenty-two arc lights and from sixty to seventy incandescent lamps in use, as well as gas-oil lamps. On the whole the town has been very fairly lit throughout that period, and at present the light supplied is excellent. The amount for public lighting per annum under the old system was £920. The work was necessitated by the cutting off of the gas supply by the local authorities, thereby leaving the town in darkness. Mr. Kingsland, who was the superintending electrician, has been appointed electrical engineer to the Yorkshire Brush Electric Light Company.

Our Mathematical Column.

TO OUR READERS.

I HAVE been in some doubt whether to take first the series of papers on the solution of Geometrical Problems, or those which I promised in an early number, on the Differential Calculus. After some consideration, however, I have decided to take the latter first, because lessons on the solution of Geometrical Problems can be obtained more easily than instruction really elementary and simple in the Differential and Integral Calculus. In the "Easy Lessons" now commenced, I propose to depart in some degree from a plan which I followed in dealing with the Differential Calculus in the pages of the *English Mechanic* some ten or twelve years ago. In pursuance of a plan suggested to me by the Rev. Mr. Griffin, of Ospringe, I propose to bring the Integral Calculus before the reader at the same time as the Differential Calculus, instead of dealing with it later on. The connection between the two subjects will thus be more clearly recognised. I propose also to illustrate geometrically as many as possible of the relations involved in dealing with the Differential and Integral Calculus, believing that in this way the real meaning and value of the methods employed will be more clearly recognised, while the interest of the subject will be enhanced.

I may notice in passing that space and time can no longer be devoted to problems set for solution by our readers—that is to say, to problems thus set in the way of puzzles. So many solutions, good, bad, and indifferent, are sent for each such problem, that the work of analysing and comparing them so as finally to publish the best, while awarding to each its due meed of praise, is more than, with our present staff, we are prepared to accomplish satisfactorily. We shall always be pleased, however, to solve, or to publish for solution, problems which may have presented difficulties to students of various mathematical subjects, provided always that such problems have real interest and value, and are not merely difficult.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. I.

The differential calculus is the science which deals with the rate at which variable quantities increase or diminish. When we say that a quantity is variable, we imply that it varies as some other quantity changes. For example, the velocity of a train is variable. It varies with the *time* which has elapsed since the train started—it varies with the *distance traversed*—with the *steam power* employed—with the *state of the rails*—and so on. But the differential calculus deals only with those quantities which vary according to some definite law.

For example, when a body is let fall from rest the distance it traverses varies, according to a known law, with the time elapsed since the fall began. The differential calculus is able to deal with such a case as this. Again the sine of an angle varies according to a known law as the angle changes; and the differential calculus is therefore able to deal with this case also.

Now we can at once see the importance of a calculus which will deal with variable quantities. Algebra and geometry and trigonometry deal with absolute quantities. But it is often very necessary to learn something about the variations of quantities, to know when a variable quantity attains its greatest value, when it is increasing, when diminishing, when it changes fastest, and so on. Whenever variations take place according to a known law, this is precisely what the differential calculus will do for us. And its great advantage is that it will solve our problems systematically. An ingenious application of algebra or geometry or trigonometry will often enable us to solve problems which belong especially to the differential calculus. But we require ingenuity for the purpose, whereas the differential calculus solves such problems with certainty, even if we have not a particle of ingenuity, so long only as we follow the proper rules. Even where it fails, it teaches us that we are trying to solve an insoluble problem.

The first matter the calculus attends to is the choice of a convenient expression for the rate at which a variable quantity changes. This expression is called a *differential coefficient*. I prefer to illustrate rather than to define it. I wish also to illustrate it in such a way as to remove at the outset the chief stumbling block of the student of this special department of mathematics. I take, therefore, a familiar case of a varying quantity:—

When a body is let fall from rest, we know that as it falls its velocity continually increases. Now this varying velocity affords a very good illustration of a differential coefficient. The velocity of a body may be described as the rate with which the space it has traversed is increasing, as the time elapsed increases. When we change the time, we change the space traversed. But unless the velocity is uniform, the change of space is not proportional to the change of time. In the case of a falling body, the velocity is not

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uniform; so that, if we consider one instant, the rate at which the space traversed would change for any given interval of time would be different from the corresponding rate at some other instant. Regarding the matter as illustrating the differential calculus, the first thing to be found is a general expression for the rate of change, —the law determining the space traversed being supposed known.

Consider now the following way of dealing with the problem:—

At the end of t seconds the body has fallen a space represented by

$$\tfrac{1}{2} g t^2,$$

where g represents the accelerating force of gravity (or numerically, a foot being taken as the unit of length, and a second as the unit of time, $g = 32{\cdot}2$). A second later the body has fallen altogether a space represented by

$$\tfrac{1}{2} g (t+1)^2,$$

so that in the course of that second the space actually traversed by the body is

$$\tfrac{1}{2} g (t+1)^2 - \tfrac{1}{2} g t^2 = g t + \frac{g}{2}$$

And if during that second the body moved with uniform velocity, we should at once know what that velocity is. For, when a body moves uniformly over s units of length in t units of time it moves over $\frac{s}{t}$ units of length in one unit of time, and $\frac{s}{t}$ therefore represents its velocity. So that the velocity of our falling body would be

$$\left(g t + \frac{g}{t}\right) \div 1$$

if the body had moved uniformly during the second. But this is not the case. The body moves faster and faster as the second of time is passing; and its velocity at time t is therefore *not* obtained by the above process. We should clearly get a better result if we took a shorter interval of time. Suppose we take a very short interval indeed, as a thousandth part of a second. Then we have as before, the space fallen in t seconds

$$= \tfrac{1}{2} g t^2,$$

the space traversed one thousandth of a second later

$$= \tfrac{1}{2} g \left(t + \frac{1}{1000}\right)^2$$

and the space traversed in the interval

$$= \frac{g t}{1000} + \frac{g}{2\,(1000)^2}.$$

So that on the false supposition of uniform velocity during this minute interval, we get for this velocity,

$$\left[\frac{g t}{1000} + \frac{g}{2\,(1000)^2}\right] \div \frac{1}{1000}.$$

or

$$g t + \frac{g}{2000}.$$

This is clearly nearer the truth, because in so short an interval as a thousandth part of a second the change of velocity is exceedingly minute. But still we have not the exact velocity.

If we had taken a yet smaller interval, as the millionth part of a second, we should have deduced for the velocity

$$g t + \frac{g}{2\,(1000000)}.$$

which is yet nearer the truth.

And the minuter the interval the minuter the second fraction becomes, the first remaining unaltered. Also, the minuter the interval the nearer we get to the true value.

But there is nothing to prevent us from conceiving that the interval is taken infinitely minute, in which case the second fraction disappears, and also we get infinitely near to the true value. This value then is

$$g t,$$

and as a matter of fact we know independently that this *is* the velocity acquired by a falling body in the time t.

Now the reader will not need to be told that I have not gone through these processes merely for the sake of deducing this special result. I want him to convince himself of the reasonableness of the above method, and also I wish him to note that though the reasoning has introduced the conception of *infinitely minute quantities*, and though the result itself is a *limiting* value, yet that result is none the less *exact*. The velocity a body has at the end of any specified time is real, and not a mere mathematical fiction or approximation. Prepared then to see that a real and exact value can be deduced by a seemingly approximate method, let him consider the following way of treating the very same problem.

Let s represent the space traversed in time t, $s + \Delta s$ the space traversed in time $t + \Delta t$ (where Δs and Δt are to be looked upon as simple quantities, which may be read, if we please, *increment of the space* and *increment of the time*; or else, for convenience, simply *delta-space* and *delta-time*).

Then

$$s = \tfrac{1}{2} g t^2 \qquad \text{(i.)}$$

$$s + \Delta s = \tfrac{1}{2} g (t + \Delta t)^2 \qquad \text{(ii.)}$$

and therefore, subtracting (i.) from (ii.),

$$\Delta s = g t \Delta t + \frac{g}{2} (\Delta t)^2$$

so that if the velocity of the body during the interval Δt were uniform, this velocity, or $\frac{\Delta s}{\Delta t}$, would

$$= g t + \frac{g}{2} \Delta t.$$

This result, however, will not be true, unless Δt is infinitely minute. Let Δt be supposed to be made infinitely minute, in which condition call it dt; then Δs also becomes infinitely minute, and may be called ds; and we get

$$\frac{ds}{dt} = g t + \frac{g}{2} d t$$

$= g t$, since $d t$ is infinitely minute or nought.

Now this quantity $\frac{ds}{dt}$, for which we have thus obtained a definite value (although ds and dt are each evanescent), is called *the differential coefficient of* s (the space traversed) *with respect to* t (the time). It is really *the rate at which the space is increasing at the time* t.

But the reader will presently have to consider differential coefficients in a general way. The above illustration has shown him how a differential coefficient is deduced in a special case; and also that a differential coefficient, though made up of seemingly evanescent parts, may have an exact value, and (what is yet more to the purpose) has *always* a *real* significance. The $\frac{ds}{dt}$ of our illustration is that real and familiar relation, the velocity of a falling body. And so the differential coefficients we have to deal with as we proceed, are real matters, not mathematical fictions.

But the above case will serve as well to illustrate the meaning of what is called integration as the meaning of differentiation—the process actually followed above.

(To be Continued.)

Our Whist Column.

By "Five of Clubs."

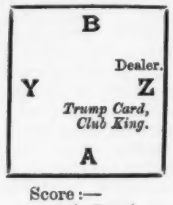
IT is remarked by several of our Whist correspondents that reasoning such as we considered in the latter portion of our last article, in dealing with play third in hand, second round, is too recondite and elaborate for actual Whist play. In reality, however, it only seems recondite because considerations which occur as card after card falls, are included in a single discussion, as if they had all to be thought over before a particular card was played. As a matter of fact, the practised Whist player attends to these matters almost unconsciously, making his inferences at the time, and using them afterwards. Thus Ace being led from Ace, ten, nine, eight, two, by himself, and six, five, three falling from second, third, and fourth players, he at once notes that either second player or third is signalling, and that fourth player is *not* signalling. He *feels* the absence of the *four* rather than thinks about it. Again, where he knows that there is no signalling, and a high card is played which does not cover one already played, the practised Whist player does not require an effort of attention to note that none of the lower cards are in that player's hand—he at once knows it, and therefore acts upon it.

The following hand illustrates the way in which inferences are made, and shows how they affect the play. They seem to require much care and attention, but are all in reality perfectly simple, and such as the Whist player with sufficient practice will make at once.

A.
Clubs—Q, 10, 5.
Diamonds—A, Q, Kn, 10, 5.
Spades—8, 5.
Hearts—K, 10, 3.

B.
Clubs—8, 7, 6.
Diamonds—K, 6.
Spades—K, Q, 10, 3.
Hearts—Kn, 7, 4, 2.

THE HANDS.



Score:—
A, *B*, = 4.
Y, *Z*, = 3.

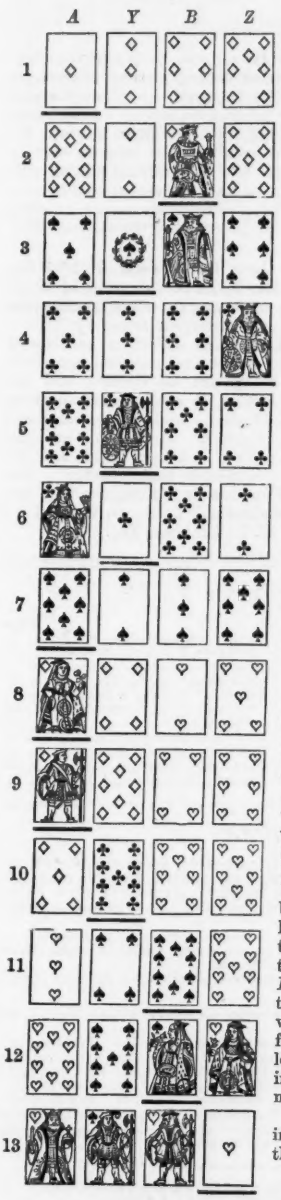
Y.
Clubs—A, Kn, 9, 3.
Diamonds—8, 4, 3, 2.
Spades—A, Kn, 9, 4, 2.
Hearts—None.

Z.
Clubs—K, 4, 2.
Diamonds—9, 7.
Spades—7, 6.
Hearts—A, Qn, 9, 8, 6, 5.

XUM

THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.



REMARKS AND INFERENCES.

1. *A* leads correctly from suit, headed by Ace, Queen, Knave, &c., see leads. *Y* begins to signal, having four trumps, two honours, and a good suit, his partner also having turned up the King. *A* alone knows, so far, that *Y* is signalling for trumps.

2. *A* shows that he has led from Ace, Queen, Knave, ten, and at least one small one. *Y* completes the signal. *Y* knows that neither *B* nor *Z* has any more Diamonds. *A* and *B* know that *Z* has no more.

3. *B* knows that *Y* holds Two and Four of Spades. *Y* knows that *B* holds the Queen and at least two others, unless, which is unlikely, *B* has led from a three card suit.

4. *Y* knows that *Z* holds Two of Clubs.

5. *Z* returns the highest of two Clubs left, and *Y*, knowing that Two is with *Z*, at once places the remaining four Clubs with *A* and *B*. It is more probable that they are equally than unequally divided, and as *A* plays the ten, the chances are in favour of the Queen being with *A*. But at any rate, the finesse of Knave would be correct.

6. *Y* is now, of course, sure of drawing two trumps, remaining with the long trump.

7. *Y*'s purpose, of course, is to draw *B*'s Queen of Spades, remaining with the tenace in that suit, and entire command, should *B* keep to his suit. But *B* sees that whether he finesses the Ten (successfully) or takes the trick with the Queen, *Y* and *Z* must win, if besides the Two and Four of Spades already placed in his hand *Y* holds Knave and another. For *Y* has two Diamonds left, and if he held originally five Spades, can have no Hearts. So that if *B* takes two tricks in Spades, *Y* will make two tricks in that suit, whatever *B* may lead, besides his long trump. Or, at the score, *Y Z* would win two by trumps. Therefore, *B* plays for the only chance left, viz., that *A* may lie over *Z* in Spades, and bring in his Diamonds. This comes off, and

8, 9, and 10. *A* makes two tricks in Diamonds, and forcing *Y* with the thirteenth, compels him

11. To lead through *B*'s tenace.

A B win the odd trick and the game, tricks counting before honours. *Y* should at trick 7 have played the long trump, trusting to *Z* being strong in Hearts. For *Y Z* want only two tricks to win besides this certain trick. Now after taking trick 7 with the long trump, *Y* leading a Diamond would put the lead with *A*, who would make the 8th, 9th, and 10th tricks in Diamonds. Then if *A* leads a Spade, *B* would most probably put his Queen on it, winning trick 11, and play Spade in turn, when *Y* would win the last two tricks in Spades. If *A* led a Heart, he would be leading up to *Z*'s presumably best suit, and there would be a good chance of the two tricks for *Y Z* in Hearts. As the cards actually lie, either course on *A*'s part (of course the latter would be bad play) would have given *Y Z* the game, unless *B* finessed the Spade 10, which he might very well avoid as dangerous.

Our Chess Column.

By MEPHISTO.

THE VIENNA INTERNATIONAL TOURNAMENT.

THANKS to the willing consideration of our printer, we were enabled to give the result of Wednesday's play in part of our edition of Thursday last; according to which Steinitz and Winawer stood at 24 each, Mason at 23, Zukertort and Mackenzie at 22½, and Blackburn 21½. Winawer had a game standing adjourned from Monday, which he finished on Thursday (against Weiss); the game extended to 135 moves, the result being a draw, as anticipated. Winawer and Steinitz having tied for first place, had to play two games (we think three would have been a better number) to decide between them. The first game of this short match, which was a championship match in the fullest sense of the word, came off on Friday. The game is of the most remarkable character, and will be a memorial in the annals of chess games. Instead of, as everybody expected, a hard fight, the two champions engaged in a game of the most dashing description, with the result that Steinitz, who got a bad game in the opening lost in twenty-seven moves, exactly the same number as in his second game to Blackburne, which was likewise lost in the opening. We have much pleasure in giving the game below. In the second game on Friday Winawer had the move, which somewhat deprived Steinitz of a chance for experimenting on the opening. White opened with a Four Knights game, and systematically aimed at a draw, as that would secure him (1½) the first prize. Steinitz fairly got into the middle of the game, and then he showed himself in his unsurpassed strength. By fine play he gradually enshrouded his opponent, or, to use his own favourite expression, "he accumulated small advantages," and, having succeeded in isolating Winawer's Queen's Pawns, he forced a passed Pawn to Queen on that wing, and won. The result of the two having won a game each was that the first and second prize (£240 and £100) were equally divided between them. The third prize (£48) fell to James Mason, of New York; the fourth and fifth prizes were divided (by mutual consent) between J. H. Zukertort, of London, and Mackenzie, of St. Louis, U.S.A.; while the sixth prize fell to Blackburne, of London. Although only sixth, Blackburne's position is really a very honourable one, as out of the large number of thirty-four games played, he was only two-and-a-half games behind Steinitz or Winawer; while at Berlin, where Blackburne won the first prize, the second man, Zukertort, was three games behind the first.

The following is the first game which was played in the tie for the Championship and First Prize at the Vienna Tournament between Herren W. Steinitz and S. Winawer, on Friday, June 23, 1882.

FRENCH DEFENCE.

WHITE. Steinitz.	BLACK. Winawer.
1. P to K4	1. P to K3
2. P to K5 (*a*)	2. P to KB3 (*b*)
3. P to Q4	3. P to QB4
4. P takes QBP	4. B takes P
5. Kt to QB3	5. Q to B2 (*c*)
6. B to B4 (*d*)	6. Q to Kt3 (*e*)
7. Q to Q2	7. B takes P (ch)
8. Q takes B	8. Q takes P
9. K to Q2 (*f*)	9. Q takes R
10. Kt to Kt5	10. Kt to R3
11. Kt to Q6 (ch)	11. K to Bsq
12. B takes Kt	12. P takes B
13. Q to QB5	13. Kt to K2
14. Kt to K2 (*g*)	14. Q takes R
15. P takes P	15. P takes P
16. B to R6 (ch) (*h*)	16. K to Ktsq
17. Q to Q4 (*i*)	17. Q takes RP
18. B to B4	18. Q to R4
19. Q takes BP	19. Kt to Q4
20. Q to Q8 (ch)	20. K to Kt2
21. Q to QR5	21. Kt takes B
22. Q to B3 (ch)	22. P to K4
23. Kt takes Kt	23. Q to Kt4
24. P to Kt3	24. R to Bsq
25. Kt to K4	25. Q to K2
26. Kt to Q5	26. Q to K3
27. Kt to B7	27. Q to R3 (ch)
resigns	

NOTES.

(*a*) This is one of the many experiments in the openings which Steinitz has made during the progress of this tourney, some of which resulted disastrously for him, his first game with Zukertort

forming a most ludicrous example. Steinitz adopted this move against Fleissig with some success, as can be seen from the game published in a former number.

(*b*) This seems a pert reply, for in case White should take the Pawn, then Black retakes with the Knight, having thereby won a move; or if White support this exposed Pawn, then Black could further proceed to develope his game by attack on the advanced position.

(*c*) A good move, having for its object the attack on the lonely outpost and also B to Kt5.

(*d*) This was either an oversight or an unsound combination.

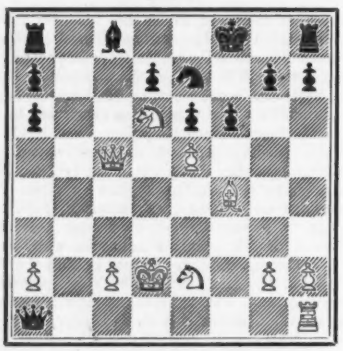
(*e*) If 6. P takes P, then Q to R5 (ch) would give White the better game. On the other hand, by playing Q to Kt3, Black almost obtains a winning advantage at once, on account of the double attack on White's QKtP and KBP.

(*f*) He elects to give up the Rook rather than the Knight, as White obtains some considerable attack, but this is very adventurous play.

(*g*) Playing after Morphy's fashion, he gives up the second Rook in order to be better able to attack, as the threatened check with the Black Queen on Q5 somewhat hampers White's movements; but it is altogether an extraordinary style of play, where issues of the highest importance are at stake. The position, however, is pregnant with ingenious combinations. We give a diagram.

Position after White's 14th Move.

Winawer.
BLACK.



WHITE.
Steinitz.

(*h*) This move cost White £70 and the First Prize. He could have effected a draw by the following play:—

Q to KR5	Kt to Kt3 (forced)
Q to R6 (ch)	K to Kt sq
Kt to K8	K to B2
Kt to Q6 (ch) and draws, for if	
	K to K2
Q to Kt7 (ch)	K to Qsq

Kt to B7 (ch) and perpetual check.

Assuming that Steinitz saw the draw, he ought to have gladly availed himself of it, as, considering he is minus two Rooks, his refusal was not founded upon sound judgment. The proper reply; any other move would be fatal; for if Q takes KtP, then Q takes BP, threatening mate either on B7 or B8, whereas now White cannot take the BP, as Black can reply with Q takes Kt (ch), followed by Kt to B4.

(*i*) Kt to B5 looked a very promising move. Black's only reply was Kt to Kt3, but some interesting play might have resulted. White might also have tried Q to QR5, in which case Black would have been compelled to play B to Kt2, giving up the Bishop, or likewise Q to KR5, in which case Kt to Kt3 is forced, then 18. Kt to B4 or Q to B3 would have given more chance to White than he obtained in the actual game.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Correct solutions of Problem 45 received from John O'Keeffe, J. Napier Belmont, Charles Hartley, A. B. Palmer, John Watson, C. W. Croskey, H. A. N., Berrow, Witton-le-Wear, Herbert Jacobs, Leonard P. Rees.

Berrow.—You are quite right. B to B4 would have been a better move.

Herbert Jacobs.—Problem received, with thanks.

Leonard P. Rees.—Problem received, with thanks. You are right, the pawn on B3 is rather suggestive, but we have put it there ourselves. Perhaps in your next you will tell us why.

Comet.—Correct solution of No. 42 already published.

COST OF THE ELECTRIC LIGHT.—In a letter to the *Times*, Mr. Crookes, F.R.S., has given the result of several months' experience with electric lighting in his own house by means of gas-engine and incandescent lamps. Omitting the interest on capital expenditure, which would not obtain to anything like the same amount by lighting from a central station, especially when reduced cost in keeping ceilings and curtains clean and maintaining gilding and book-bindings is taken as against it, he finds the actual cost to him to be £2. 19s. per month. Gas lighting to the same extent, he says, would cost £3. 6s. 6d. He has in his house altogether about fifty lamps of different powers.

ANTHROPOLOGICAL INSTITUTE. — June 13, General Pitt-Rivers, F.R.S., President, in the chair. Mr. Mann S. Valentine, of Richmond, Virginia, exhibited a series of figures carved in steatite and mica schist, forming part of a large collection found by him in Virginia and North Carolina. The whole collection consists of some 2,000 specimens, consisting of various animals and household utensils, cups, &c. The human beings are all clothed, and are represented riding on animals and sitting on chairs, and indicating a remarkably advanced state of civilisation; and in some instances obvious traces of contact with Europeans. Mr. A. H. Keane described the district in which the objects had been found, and the tribes that were known to have inhabited that country. The following papers were read:—"Nepotism in Travancore," by the Rev. S. Matur; "The Laws of Madagascar," by Dr. G. W. Parker; and "Cummer, Co. Wexford," by G. H. Kinahan, Esq.

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